

THE FALLACY OF THE MASSACHUSETTS MIRACLE ★ WAITING IN LINES (HAPPILY) ★

★ LESTER BROWN ON THE STATE OF THE WORLD ★

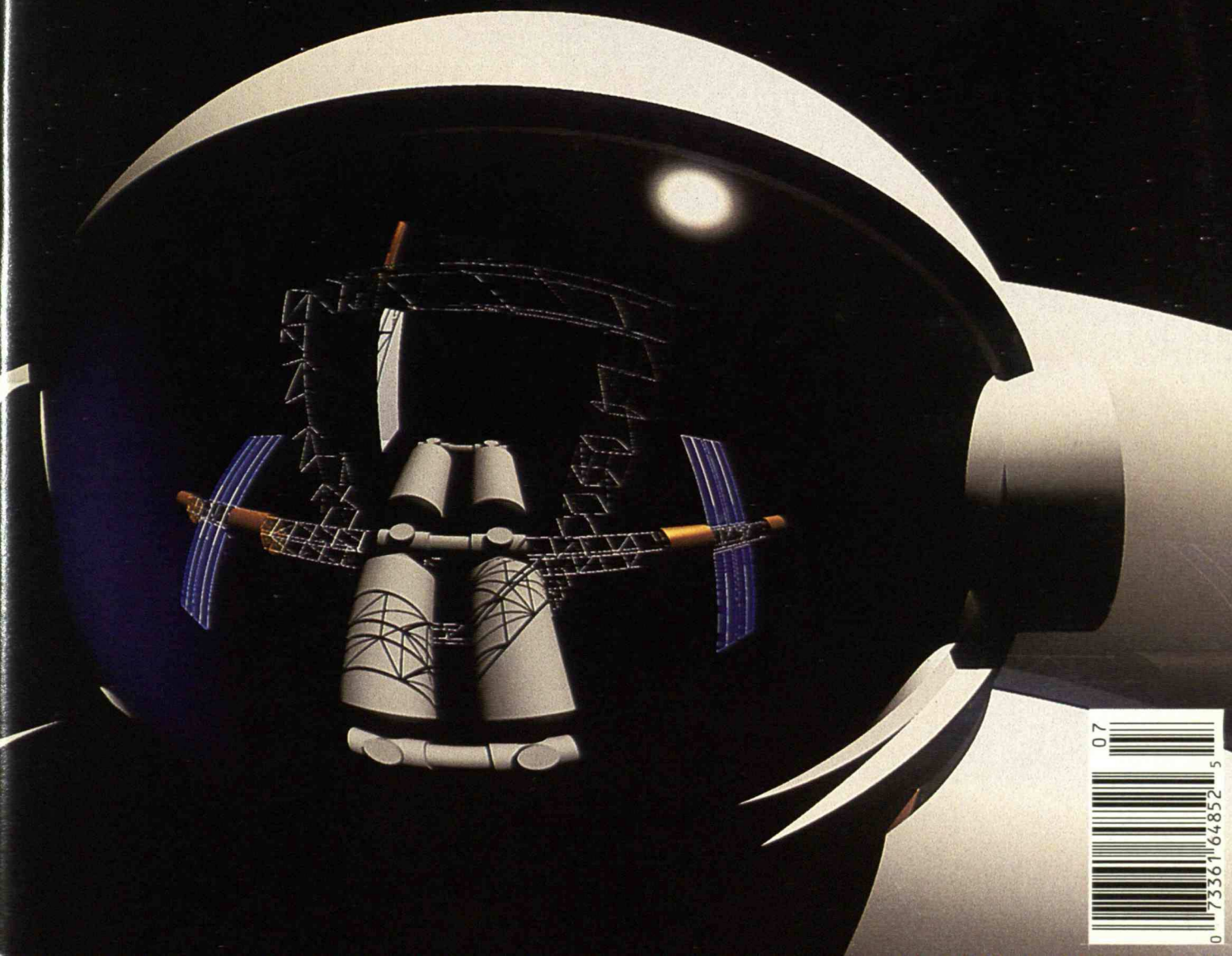
# Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

JULY 1988

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## SPACE STATION: READY FOR OCCUPANCY 1998



# technology review

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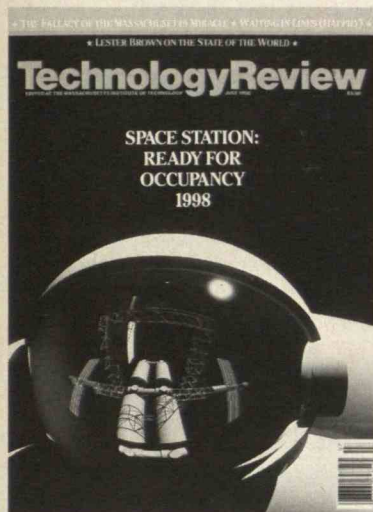
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## FIRST LINE

FROM THE EDITOR

# Popular Non-Science

At a major M.I.T. event in Washington late last spring, Paul E. Gray, president of the Institute, berated the nation and its schools for what he sees as the country's increasing scientific illiteracy. He cited the familiar statistics: on average, U.S. high-school students take only one year of science; fewer than half study three years of mathematics. Many graduates of collegiate liberal-arts programs have "no significant involvement" with science or mathematics, said Gray.

Do these facts make a difference? They do. According to surveys by the Public Opinion Laboratory of Northern Illinois University, more than 40 percent of all Americans disbelieve the Darwin-based theories of human evolution; the same proportion believe in the existence and alien origin of UFOs. Many hold costly misconceptions about the disposal of low-level radioactive materials. As Fred Jerome notes in this issue (page 25), almost half of U.S. newspaper editors say that dinosaurs and humans lived contemporaneously.

Yet a dominant proportion of Americans are confident that science and technology have positive effects on work and employment. Scientific research is generally recognized as useful and important.

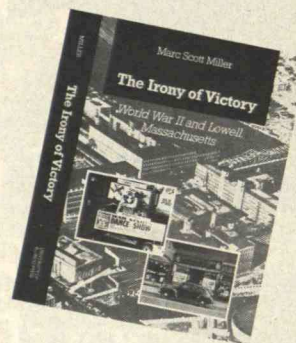
Scientists and engineers can ill afford complacency about this curious combination of uncritical confidence and misinformed judgment. M.I.T. physicist Philip Morrison, who has done so much to spread the understanding of science in the schools, fears its isolation, surrounded by "a sea of onlookers, bemused, indifferent, and even hostile."

Though this magazine is not edited for that "sea of onlookers," we identify with Gray's goal: "We must develop a popular understanding that engineering and science are, by their nature, not esoteric quests [of] the elite few but humanistic adventures deriving from native human curiosity about the world around us and a drive to make it better."

## LOWELL IN WORLD WAR II

We are pleased to report the publication of *The Irony of Victory* (University of Illinois Press, 1988) by Marc S. Miller, senior editor of *Technology Review*. Miller's book results from a pioneering study of the effects of World War II on everyday life in Lowell,

Mass., combining traditional research with oral history and emphasizing how social class determined the war's impact. Miller chose to study Lowell because that city was both the birthplace and the victim of modern industrial capitalism in the century before the war. The dramatic changes brought to Lowell "clarify trends that more moderate experiences in other communities might obscure," writes Miller.



## INTRODUCING BENNETT HARRISON

We announce with pleasure that Bennett Harrison's contribution to this issue ("*Second Thoughts on the Massachusetts Miracle*," page 20) marks the beginning of a series. Harrison is a specialist in economic development and urban economics associated (since 1973) with the departments of Urban Studies and Planning and of Economics at M.I.T. His recent work has concerned the relationships among technology, wages, and jobs, and one special aspect of this is the subject of his first contribution to the *Review*.

Harrison's columns, which will appear in alternate issues, replace those of Marshall Goldman, who has contributed regularly to the *Review* since 1984. Goldman has decided to concentrate his future writing in the field of Soviet studies, which is his specialty; he serves as associate director of Harvard's Russian Research Center as well as professor of economics at Wellesley. We have reluctantly accepted Goldman's resignation from his four-times-a-year commitment—but with confidence that readers may expect his contributions to continue, if with less frequency, in future issues.

John I. Mattill



# The Constrained Curve





# The Constrained Curve

*The geometric path traced by a robot arm is independent of time. Now a mathematician at the General Motors Research Laboratories has devised a simple, innovative way to relate the path to time so that the machine can track the path and meet specific performance objectives without exceeding its physical operating limits.*

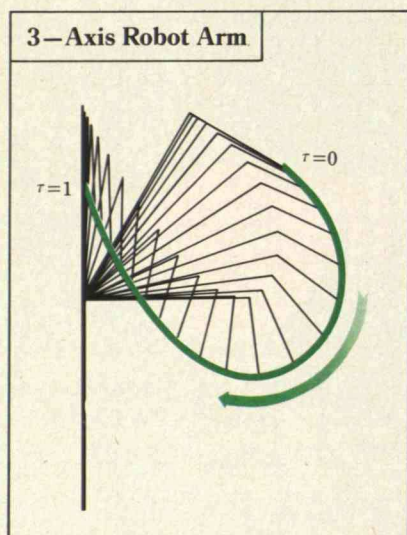


Figure 1: Schematic diagram of a 3-axis robot tracing a path in 3-space.

Figure 2: Results for Figure 1 path. I: Plot of the change of variables,  $t=h(\tau)$ . II, III, and IV: Normalized velocity, torque, and rate of change of acceleration for the waist, shoulder, and elbow (for any variable, a value of  $\pm 1$  indicates operation at a limit).

Industrial robot arms are very good at repeating a well defined motion with a high degree of accuracy. A robot with a welding tool, a paint sprayer, or a grasping device at its tip can weld in the right spot, spray a precise pattern, or locate a part in a given place time after time.

This untiring precision makes robots valuable in a quality-oriented manufacturing process such as the assembly of an automobile. That's why General Motors has installed so many robotic manipulators in its plants, and why GM is intent on developing technology and software to use these machines to their best advantage.

When a robot is to apply sealant to a windshield opening, or move a part from one point to another, its tip is positioned at points along a fixed geometric path, always maintaining the orientation needed to perform the task.

Mathematically, tip position along the path can be described as a func-

tion of a one-dimensional position parameter  $\tau$  that ranges from 0 to 1 as the path evolves from beginning to end. Actually, for a robot having three joints, Figure 1 for example, tip position is determined by a set of three functions of  $\tau$ , one for each joint of the arm. Each separate joint function relates a specific angle of rotation,  $\theta$ , about that joint axis to a given value of  $\tau$ .

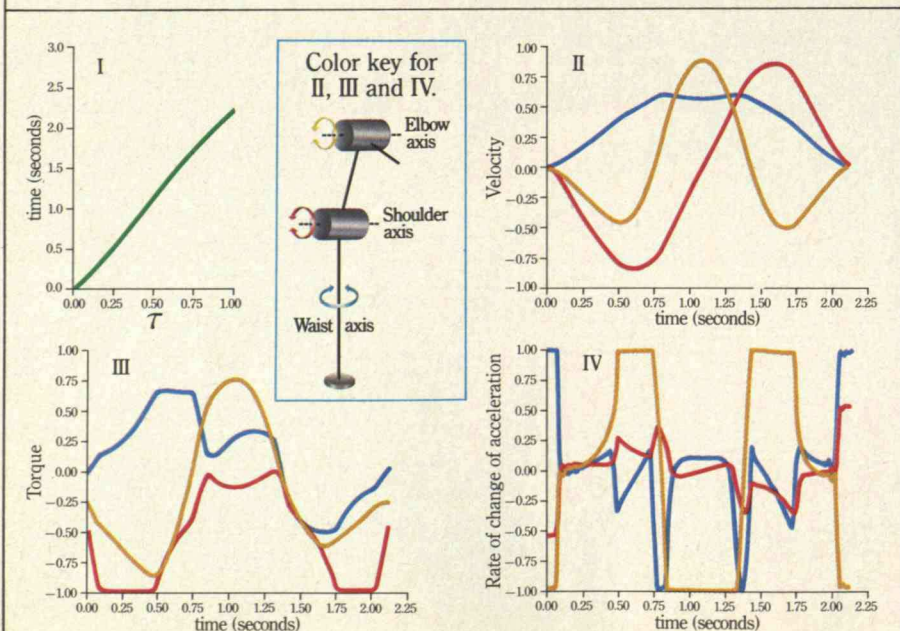
To get the robot to perform a task, however, its computer controller must associate each point on the path with some value of time—in effect telling the robot to be in position A at a certain time, position B at another time, and so on, throughout the path.

Establishing an appropriate correspondence between time and the path position parameter is an important prerequisite to actually controlling the robot to follow the path.

Dr. Samuel Marin, a mathematician at General Motors Research Laboratories, has devised an effective and efficient means of computing the required correspondence. His work addresses productivity concerns. Dr. Marin's objective is to make cycle time (the time it takes the robot to trace the path from beginning to end) as small as possible, yet to respect at all times the physical operating limits of the robot.

Dr. Marin noted that by seeking a correspondence that gives time explicitly in terms of the path position parameter,  $t=h(\tau)$ , the problem's character changes. It appears not so closely associated with control theory, where the problem has also been studied, but more like a problem of nonlinear optimization.

Setting  $g(\tau)=h'(\tau)$ , the derivative of  $h$  with respect to  $\tau$ , allowed Dr. Marin to pose the minimum time prob-





lem in the following way: minimize  $\int_0^1 g(\tau) d\tau$ , subject to some constraints dictated by the physical operating limits of the robot mechanism. These limits on the robot—limits on velocity, acceleration or torque, and on rate of change of acceleration (Fig. 2)—can all be formulated as differential inequality constraints and are all expressible in terms of the unknown function  $g(\tau)$ , as:  $g(\tau) \geq G(\tau, g, g', g'') \tau \in [0, 1]$ .

If the problem could be discretized, making it in some sense finite, it could be put on a computer and solved numerically. So Dr. Marin replaced the unknown function with a piecewise cubic approximation.

This allows the search for the unknown function to be confined to a class of functions that are completely characterized by a finite number of coefficients in a B-spline series.

He similarly discretized the constraints, replacing the infinite set of constraints with a finite dimensional subset that could be dealt with numerically.

He completed the formulation of the discrete problem by incorporating a grid-refinement strategy. Now the problem's dimension could be gradually increased to better approximate the continuous case.

What resulted was a classic nonlinear optimization problem, a finite dimensional problem in which it remained only to find the coefficients of the B-splines while satisfying the constraints.

A monotonicity property of this problem coupled with properties of the approximation method suggests that the simple technique of cyclic coordinate descent might best provide a solution.

"While not so effective in other applications, a cyclic coordinate descent-based algorithm appears to be exactly what is needed in this class of problems," notes Dr. Marin. "With modifications introduced to ensure that the iterates are strictly feasible, this method has consistently and rapidly solved the problem."

Working closely with mathematicians at Rensselaer Polytechnic Institute, Dr. Marin is confirming this method's utility. In comparisons so far with several widely used, general-purpose optimization codes, the special method consistently shows itself to be superior.

"My work in path parametrization is just part of the story here at GM," emphasizes Dr. Marin. "Many aspects of this problem's formulation are rooted in deeper concerns about how robots can be made to move faster and more accurately. These concerns originated in the work of Dr. Robert Goor, my colleague in the Mathematics Department, and have motivated several significant advances in robot control and trajectory planning."

"Until all the pieces are put together in a production system, it's difficult to gauge the full value of this work. However it will help reduce our manufacturing costs and will enhance our product quality."

## General Motors



## THE MAN BEHIND THE WORK



Dr. Sam Marin is a Senior Staff Research Scientist in the Mathematics Department of the General Motors Research Laboratories. He is also the Manager of the Department's Mathematical Analysis and Computation Section.

Dr. Marin received his undergraduate degree in mathematics from St. Vincent College in Latrobe, Pennsylvania, and holds both an M.S. and a Ph. D. in that discipline from Carnegie-Mellon University. Between graduate degrees, Sam was an officer in the U.S. Navy, teaching mathematics at the Naval Nuclear Power School.

Since joining General Motors in 1978, Dr. Marin has pursued interests in numerical analysis and approximation. He has published research relating these areas to a variety of applications, including robotics, geometric curve design, and acoustics.

Sam is a member of the Society for Industrial and Applied Mathematics. He lives in Rochester Hills, Michigan, with his wife and two children.



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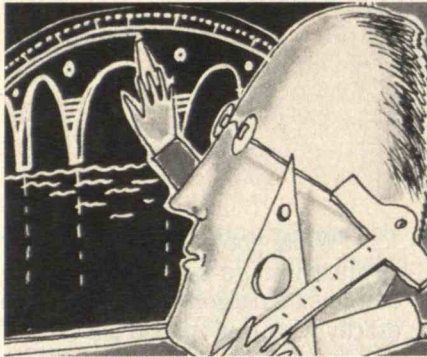
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## LETTERS



### THAT OLD-TIME ENGINEERING

I agree with almost everything Kerr and Pipes say in "Why We Need Hands-On Engineering Education" (October 1987), but I think they are aiming at the wrong target. We will never correct deficiencies in undergraduate education until we revamp the graduate education we use to produce engineering teachers.

First of all, engineering is more than just research and design. I prefer a definition similar to the one put forth by the Accrediting Board for Engineering and Technology: "Engineering is the art or science of producing artifacts or systems that people want at a price they can afford to pay." This involves development, testing, sales, design of the tools for manufacture, economic and marketing studies, and, if appropriate, instruction and maintenance. That was the scope of old-time engineers such as the Wright brothers and Henry Ford, and it still holds for inventors and entrepreneurs.

The trouble is that most of our faculty members, by the above definition, are not engineers. They are researchers or analysts. I remember with horror an orientation session for freshman engineers at which a skeptical student asked the professor, "Just what do engineers do, anyway?" The reply was "Why don't you come to my office and I will show you my research." I also recall a civil engineer who presented a new design for a suspension bridge as his thesis for a degree. He was turned down because he had not done any research. Three years later the candidate was awarded a world prize for innovative design, and later the bridge was built—but he still didn't receive his degree.

If we are going to require a doctorate for tenured professorship, we must reform our requirements for that degree. Let us have theses describing the design of sys-

tems and artifacts that are new and different. When feasible, students should have to construct the systems or artifacts described (or models of them), and certainly an economic study should be made.

ERIC A. WALKER  
University Park, Pa.

*Eric A. Walker is president emeritus of Pennsylvania State University.*

### CHINESE BRIDGES

In "Anonymous Heroes" (January 1988), Samuel Florman says the inventors of suspension bridges are very well known. However, that is not the case: the true inventors are unknown to most people. Suspension bridges have been built in China for many centuries, some with wood and rope and others with wood and wrought-iron chains. Fifteenth-century European accounts strongly suggest that the technique for constructing suspension bridges was learned from China.

PAUL TSENG  
Cambridge, Mass.

### GIVING SDI A FAIR SHAKE

I wish to take issue with some of the statements questioning the feasibility of missile defense in "The Confused Course of SDI" by Peter Clausen and Michael Brower (October 1987). The authors indicate that a chemical laser would require phase synchronization to produce 20 megawatts, and that that is a frightening challenge. Yet in the next sentence, they mention that the Strategic Defense Initiative (SDI) is actually testing a 2-megawatt prototype now. Why is one more order-of-magnitude scaleup impossible? The same technology was producing only watts a few years ago.

In addition, Clausen and Brower imply that the SBKKV (space-based kinetic kill vehicle) cannot accelerate to five kilometers per second, but this technology was demonstrated by the army more than a decade ago. They also doubt that the infrared sensor could navigate the interceptor to a kill, but they mention the Delta 180 experiment wherein radar provided the interceptor guidance. The logical answer to their concern is an integrated, dual-mode infrared sensor plus millimeter-wave radar. A version of such a seeker was demonstrated more than five years ago.

The infrared sensor can provide guid-



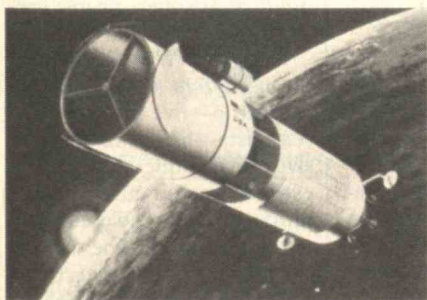
ance until the radar locks onto the booster body. Once locked on, the radar is very hard to spoof or jam, as its beam is very sharp. A system of this sort greatly reduces the advantages claimed for fast-burning boosters; after the infrared sensor has guided the radar to lock-on, the booster flame is no longer required for accurate guidance to a kill.

As for the threat of Soviet "space mines," I cannot imagine a target better able to defend against them than a garage full of U.S. interceptors. The time and distance between booster burnout and warhead reentry provides a long and stable period for intercept. Building decoys that can spoof multi-frequency infrared sensors and neutral particle beams is not nearly as simple as the authors imply.

Terminal defense is relatively easy, of course—since the atmosphere would help discriminate between decoys and warheads. So one should not rule out defending targets such as cities; non-nuclear interceptors appear quite feasible. Even if low-yield nuclear interceptors were used, the damage would be much less than from the enemy's groundbursts.

Finally, why is the Soviet Union so concerned about abolishing or curtailing SDI if it is as futile a defense as Clausen and Brower seem to think? The reason must be that the Soviets can never be absolutely sure how good or bad it really is. Such uncertainty is the essence of deterrence: if the Soviets doubt whether their missiles can make a successful attack, they will never launch one. It is also important to remember that the world is far more complex than the simple U.S.-Soviet dichotomy. Some terrorist nation might soon hold the entire planet hostage by threatening to hit any one of its hundred largest cities with a crude nuclear weapon. SDI might be able to defend us against that.

J.H. GOLDIE  
Seattle, Wash.



## *The authors respond:*

The American Physical Society report on directed-energy weapons estimates that the maximum power for a chemical laser is 5 to 10 megawatts. One key problem is the enormous thrust and torque created by the high-volume flow of chemical fuel, which must be exactly balanced by the space platform. Another problem is the optical system, which is sensitive to vibrations and thermal expansion. The vibrations are in turn aggravated by the mirrors that are needed to prevent overheating. Finally, the ultimate potential of the laser cannot be explored except through full-scale experiments in space (illegal under the 1972 Anti-Ballistic Missile Treaty).

We did not say that the speed of the SBKKV could not be raised beyond five kilometers per second—only that this is roughly the goal of research aimed at early deployment. Raising the speed substantially beyond five kilometers per second would greatly increase the weight of the rocket, and therefore the cost of putting it into orbit. Improvements such as cutting the weight of the kill vehicle do not hold great promise for changing the situation, because the exponential dependence of interceptor weight on maximum speed tends to dominate all other factors. As for radar sensors, they would also multiply the interceptor's weight, and official statements indicate that they are not being considered.

Although an SBKKV garage could fire an interceptor at a space mine, the mine could be fused to explode when hit. The same goes for any nuclear warheads the United States might try to stop at low altitudes over cities. However, we have never maintained that high-altitude city defense, whether nuclear or not, is unworkable.

Intercepting the reentry vehicles that carry the nuclear warheads would not be cost-effective, even without the problem of decoys. Each interceptor could destroy only one reentry vehicle at best, and several would have to be put into space for each reentry vehicle that happened to be in range. Furthermore, despite Goldie's assertions to the contrary, hiding reentry vehicles inside aluminized mylar balloons (for example) would fool almost all sensors except high-power lasers and neutral particle beams, which would be extremely expensive and vulnerable to attack. Even though the SDI Organization regards the

*Continued on page 78*

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# TRENDS



## Mr. Wizard's *Wetenschapswinkel*

**E**ver wonder what was causing the trees in the neighborhood to lose their leaves earlier each fall? Or how to dispose of decade-old paint thinner? Or whether your broken fire alarm might expose you to low-level radiation?

If you lived in Holland you would know who to ask about such science and technology matters that impinge on everyday life. For more than 10 years, the Dutch have pioneered publicly funded *wetenschapswinkels*—science shops—at almost every university in the country. Functioning as a local, scientific Peace Corps, these offices field questions of concern to clients who can't afford to pay consultants and whose need to know is not commercially motivated.

To accomplish the mission of applying ivory-tower technical resources to socially relevant, real-world problems, at least two full-time paid employees, plus a sizable number of students, staff each *wetenschapswinkel*. When a

shop can't solve a problem by looking up the answer, it taps the expertise of scientists at the affiliated university. Part of each faculty member's job is to share research skills and advice on the local technological issues that arise. The students receive stipends and/or credit for their contributions.

Peter Frijns, a student at the Eindhoven University of Technology in the south of Holland, works in the "chemistry consultancy shop." Like most cities, Eindhoven has a network of science shops divided by discipline. Eindhoven's *wetenschapswinkel* network contains eight departments, ranging from physics to architecture and health care.

While Frijns says funding is too limited and the shops often lack up-to-date facilities, he speaks with pride about goals and successes. He cites the story of a major environmental problem connected with the metallurgical industry in Eindhoven and across the border in Belgium.

A local environmental group was worried that the

metalworking factories were contaminating produce grown in the region. Eindhoven science-shop members, with help from university chemists, analyzed both the soil in local vegetable gardens and trace amounts of heavy metals in the vegetables themselves. Discovering alarmingly high levels of cadmium—a by-product of zinc refinement—the Eindhoven shop documented a problem far more serious than had been previously realized.

The Dutch government has since begun a multi-million-dollar cleanup, which includes modifying existing factory practices. On behalf of its client, the Eindhoven shop is monitoring the cleanup closely.

### Here to Stay

The metalworking case is a highly politicized one with major public-policy ramifications, but science-shop research is often oriented to individual needs. For instance, for people with dis-

**Since 1977, Amsterdam's "science shop" has answered thousands of technical questions from the public.**

abilities Eindhoven's "health-care technical consultancy shop" has designed and adapted products, including a bicycle for an amputee and a vacuum cleaner for a client confined to a wheelchair.

Amsterdam's *wetenschapswinkel*, the largest and oldest of Holland's 42 shops, has answered thousands of technical questions since its inception in 1977. A local union wanted to know if ultraviolet light used in offset printing was hazardous. An elder client wondered if the Dancan brand of cleaner would damage dentures. The local Amnesty International chapter asked the psychology branch if more explicit literature would strengthen sentiment against the torture of political prisoners or just create revulsion.

Hetty van Weelden, one of seven staffers at the Amsterdam shop—five of whom are scientists—fields an impressive range of queries daily. He estimates that about two-thirds can be answered with existing research. The rest are candidates for research ef-





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forts initiated by the science shop itself. Because projects can take years and resources are limited, the staff decides what to take on based on who is asking, what their need to know is, and how well the needed research matches the available expertise.

Van Weelden says that since Amsterdam's shop was officially launched more than a decade ago, *wetenschapswinkels* have weathered a fair amount of restructuring and debate on their role within the university. Some faculty and students have been reluctant to take up the research because it takes them away from their regular work. And sometimes the caseload is so overwhelming that the staff doesn't have enough time to give its best to each request. As a result of such questions, the *wetenschapswinkel* shops have become more integrated into the affiliated universities.

Today, Holland's science shops "seem to be here to stay" because they "fill a real need," according to van Weelden. Not only do they answer serious questions about technical issues, but he thinks they also make an important statement about the responsibility of university scientists to address public concerns.

Van Weelden reports that Holland's idea is spreading. West Germany opened its first science shops several years ago, Sweden adopted the idea in 1986, and last October Finland formally began its own science-shop network. Recently, representatives from Australia visited the Amsterdam shop. "Now maybe we'll see some science shops 'down under,'" he says. "But how about you in America?" □

SETH SHULMAN is a frequent contributor to *Trends*.

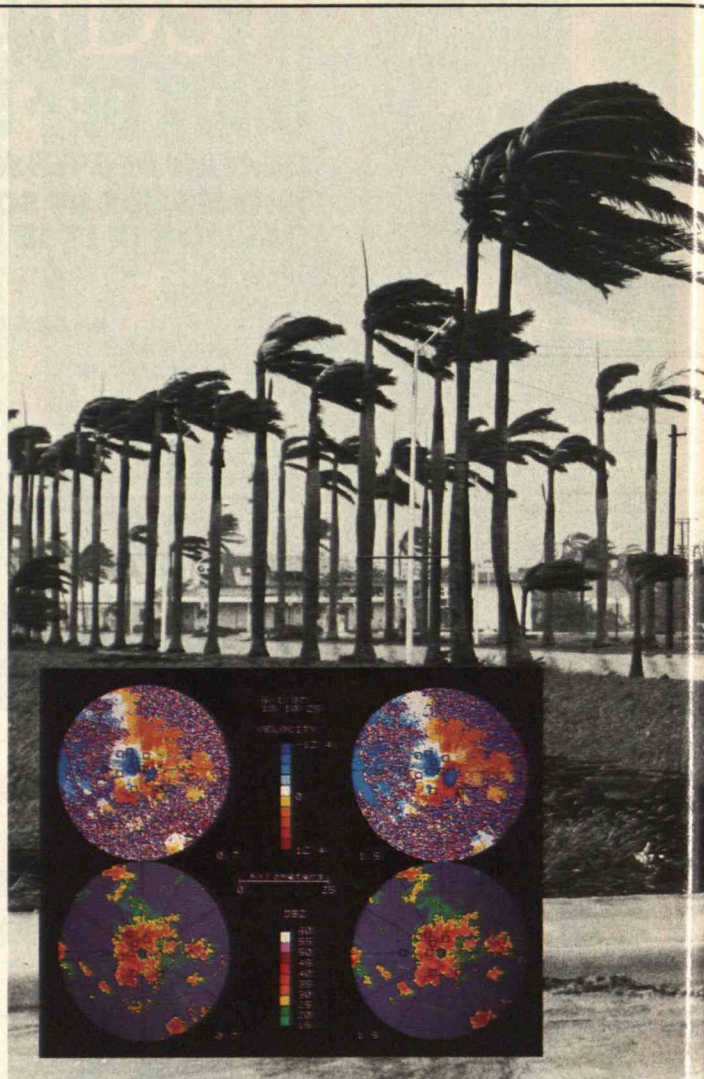
## Chaos and the Real World

**W**hen Edward Lorenz talks about forecasting the weather, he thinks about butterflies. Imagine a butterfly stirring deep in the Amazon forest. Its delicate motion alters tiny air currents that influence large eddies ever so slightly. Can those eddies transform a Texas tornado days later?

That possibility—known as the Butterfly Effect—stirred meteorologists when Lorenz used the image in the early 1960s. "The Butterfly Effect is significant in that if I sneeze, I change the atmosphere today and maybe I change the climate," says Aksel Wiin-Nelsen, director of the European Centre for Medium Range Weather Forecasts. If the weather is sensitive to such minute influences, no one could predict its course.

While Lorenz's work dealt a theoretical blow to weather forecasting, it helped lay the foundation for a science just coming into its own. Called nonlinear science or dynamical systems theory, it is known informally as "chaos."

Ever since Galileo described the motion of a pendulum, scientists have been trying to explain complex behavior with linear equations, where a given input produces a proportionate output. With the advent of computers, scientists were optimistic that they could fulfill the promise of the "clockwork" universe of Pierre Simon de Laplace and René Descartes. The



eighteenth-century mathematicians had speculated that the complete understanding of each part of a system would allow its entire future to be described.

By the 1950s, meteorologists were among those who thought the new machines could accomplish this task. "We thought that if you just knew the state of the atmosphere sufficiently well and if you built the right models with powerful enough computers, there should be no limit in predicting the weather," Wiin-Nelsen says. "Lorenz's work came as quite a shock."

Working with a primitive computer model at M.I.T. in 1961, Lorenz simulated the weather. His model was as

simple as they come—temperature, wind speed, and pressure, but no rain, no day, no night, no seasons. He plugged in a few measurements and watched the weather unfold.

### Exquisite Dependence

Lorenz's global weather parody worked well enough until he tried to duplicate the results. The second time around he entered rounded-off numbers, and the result was chaos. The tiny numerical error became more and more exaggerated, until it was amplified into an entirely different weather pattern.

This taught Lorenz two key lessons. First, models of chaotic systems have an exquis-





**The new science of "chaos" could help predict the weather—but it might also cast doubt upon any forecast for a date more than three weeks away.**

Computer models that predict the weather, for example, appear to be accurate for a maximum of two or three weeks. Those limits have been set by simulating past weather. The models start out fine, but soon they bear as much resemblance to the true weather as a weather map picked at random.

"If you know you can't predict beyond a certain point, it tells us what our efforts should be," Lorenz says. "It has a good deal to do with how we spend our funds on improving the forecast, where we put our weather stations."

Equally important to forecasting the weather is the recent discovery of order in chaos. On its journey to disorder, nature usually takes a few well-beaten paths. In the jargon of nonlinear science, the patterns are "attractors," a set of states to which systems tend to go. Every snowflake is unique, yet almost all have six arms.

In meteorology, scientists look at persistent weather patterns for clues to underlying behavior. Some meteorologists think that "blocking," which occurs when a high-pressure system blocks the usual path of the jet stream, signals the working of an attractor, an indication that the weather somehow "prefers" such patterns. Says UCLA professor of atmospheric science and geophysics Michael Ghil, "Chaos theory says these systems are not utterly random." He thinks chaos eventually

might explain why one path is more likely than another.

Ghil, who has been collaborating with National Weather Service meteorologists, says chaos theory hasn't yet percolated down into models for forecasting next week's storm, but it is helping understand the weather. "We haven't had anything a physicist would recognize as a real theory of long-range forecasting," says Donald Gilman, prediction branch chief at the service's Climate Analysis Center in Maryland. He thinks chaos and attractors "might present a way of looking at the atmosphere's variations on more than a daily time scale."

There are skeptics. Peter H. Stone, director of M.I.T.'s Center for Meteorology and Oceanography, says that scientific observations have yet to conclusively prove the existence of attractors. Some mathematicians say the methods of chaos theoreticians lack rigor, are based on unreliable models, and threaten traditional ways to test solutions. Others question whether chaos has any meaningful applications.

Nonetheless, chaos theory is gaining a following. Today, it has advocates at every major university and corporate research center, and the science is providing a way to study systems that defy description by conventional methods. For example, Harry L. Swinney, a physicist at the University of Texas at Austin, has applied the technique to his study of fluid mechanics. As he says, "Chaos theory is a fresh way of looking at problems that are very difficult and in which there are very few fresh ideas." □

ANN GIBBONS is a Knight Science Journalism Fellow at M.I.T.

itely sensitive dependence on initial conditions—the Butterfly Effect. And second, even simple systems can show complex, chaotic behavior. In other words, the clockwork universe doesn't exist.

At first, Lorenz's work passed unnoticed, published in an obscure meteorological journal. But in the 1970s, James A. Yorke, a University of Maryland mathematician, rediscovered the article and distributed it from coast to coast. By that time, more scientists were ready to accept nature's disorder. Armed with powerful computers to model complex behavior, they were coming to a creeping realization that chaos in weather had a lot in common with the crashing course of a

mountain river, the random roll of dice, the fluctuating populations of wildlife.

Today, chaos is a science that is highly mathematical but unusually interdisciplinary. Physicists, chemists, biologists, mathematicians, and engineers are among its students. They specialize in turbulence and deal in disorder. Says Philip Marcus, a mechanical engineer at the University of California at Berkeley, "If you want to understand the world around you, you have to look at chaos."

#### Order in Chaos

For meteorologists, one of the chief values of chaos theory is that it establishes limits.



## Software Soprano

**V**incero, vincero," sings the crackly tenor, and it is quite possible to imagine that an early 78-rpm record on a just as ancient gramophone is playing Puccini's *Turandot*.

What is happening, in fact, is that Ingo Titze, University of Iowa professor of speech pathology and audiology, is using a computer to recreate his own operatic efforts. It is not a trick but one of a number of recent advances in mimicking and possibly improving perhaps the most difficult musical instrument to copy—the human voice.

The purpose of the research is twofold. The first goal is to explore the capacity of computers to recreate the variations and emotionality of human singing. The second could lead to the first true "science" of voice training.

There have been some notable successes on both fronts. In 1986, Harrison Birtwhistle's prize-winning opera *The Mask of Orpheus* specified that the role of God would be sung by a voice generated at the Paris-based Institute for Acoustical Music Research (IRCAM). The same researchers have fabricated Louis Armstrong's sweet and mushy singing.

Moreover, a Swedish-accented computer rendition of Verdi's "Lacrimosa" aria—created by Johan Sundberg of the Royal Institute of Technology in Stockholm—will soon be heard on a compact disk issued in conjunction with *Some Current Directions in Computer Music* to be published by M.I.T. Press this fall. Referees unaware of

the voice's mechanical origin judged it good enough for the University of Stockholm's doctoral music program.

Researchers talk of a variety of uses for a computerized singing voice. Titze suggests that it might be used in tandem with human singers to generate music beyond their normal range. Computerized notes could be held longer and at higher or lower tone levels and then patched onto the singer's efforts. John Chowning of Stanford University's Center for Computer Research in Music and Acoustics—CCRMA, pronounced "karma"—says computer synthesis might one day mimic singers so accurately that music written hundreds of years after their death could be sung in their voice.

However, researchers admit that the road toward a true parity with human singing remains bedeviled by obstacles. In particular, they have no theory of singing to refer to in constructing a computer algorithm. Furthermore, while tone and pitch accuracy are important, they can't take a backseat to emotionality and musical expression. The sudden appearance of an inappropriate tone—a happy note in a sad song, for example—would be quite unsettling. As Sundberg says, "Sound is boring as long as you just translate tones."

Chowning presents an-

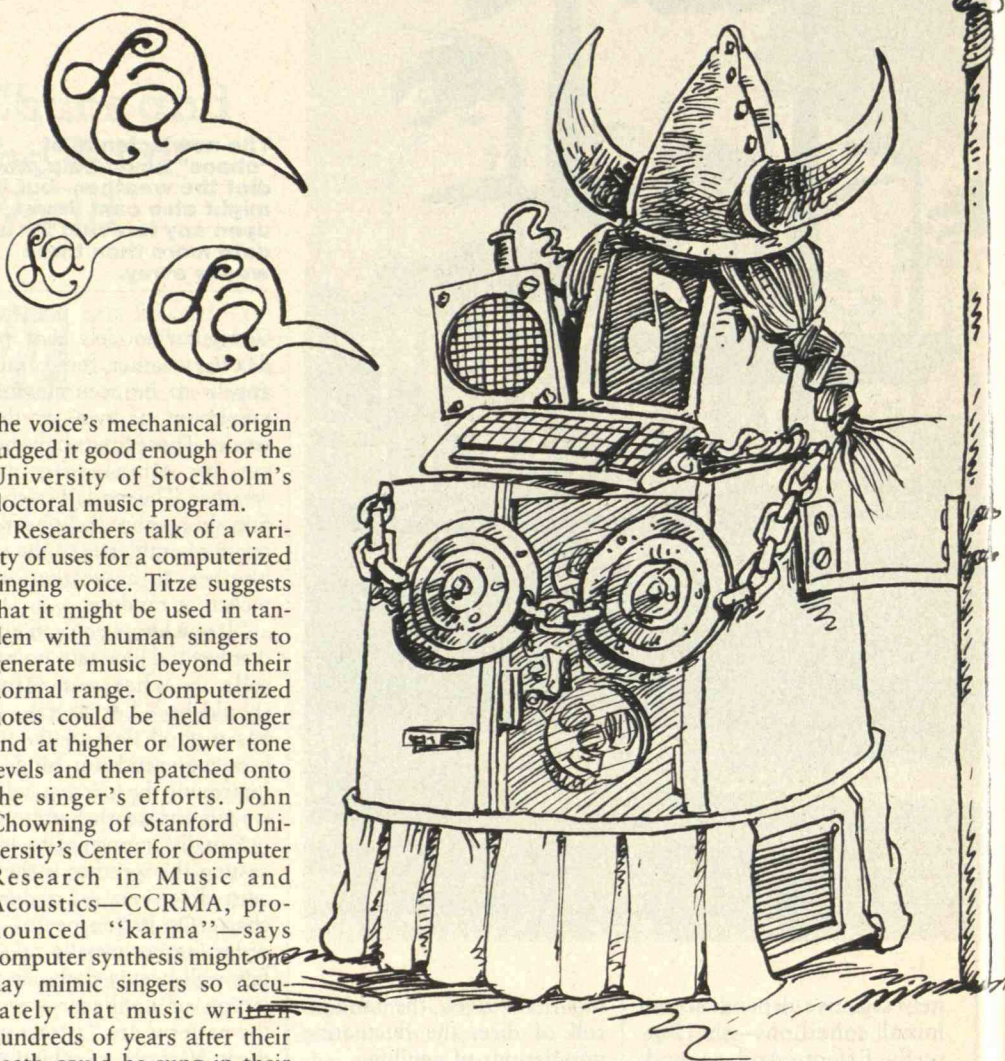
other technical problem: in singing there is no standard of quality equivalent to the Stradivarius violin, and consequently computer simulators have no clear-cut model to replicate. Stanford researchers have shown that people will tolerate a greater variation in the sound range of "good" voices than they will in "good" musical instruments.

Other CCRMA research has achieved human-like sounds that remove all the individual vibrations characteristic of a person's vocal cords. The results are less aesthetically pleasing than sounds in

which the vibrating "imperfections" of the normal singing voice remain. Titze remarks that the experiments so far have been ad hoc efforts to add what sounds like the correct amount of speed, sprightliness, timing, loudness, and inflection to tones.

### The Singing Teacher

Amidst the struggle to conceive the singing synthesizer, many researchers suggest that the greatest contributions may not come in competing with the human voice but in understanding its physiology. While IRCAM and some





other centers are computer-music oriented, elsewhere the drive is to use computer simulation to analyze how humans produce song. For example, Sundberg describes his simulation efforts as a screwdriver that he is using to pry open the "black box of the human voice."

Using body-scanning techniques such as nuclear magnetic resonance and ultrasound, Titze hopes to compose an individualized portrait of a singer's entire "instrument"—the respiratory system, larynx and vocal cords, and upper vocal tract. Already Titze and his colleagues at the Denver Center for the Performing Arts have assembled a computer representation of the larynx that yields different sounds when a program changes the shape of its "vocal cords."

The next step might be song-producing simulations. Parts of the computer-simulated vocal system could be modified, and researchers could analyze what effect this change had on tone or clarity or other kinds of musical expression.

Titze thinks such simulations could revolutionize voice training. While many teachers suggest voice-training exercises, no one has any clear evidence on which is the best, he says. He likens the situation to pre-scientific athletic training, in which runners were told that simply running more was the best way to improve performance. If researchers could directly simulate what happens in the vocal apparatus—the vocal cords, the larynx, the mouth, the nose—they could learn exactly how and why techniques improve singing. □

*STEPHEN STRAUSS is a science reporter for the Toronto Globe and Mail.*

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## Un-Crude Answers

**A** few years ago, the accidental release of the pesticide kepone into a Virginia river damaged the livelihood of workers on Maryland waterways. More recently, radiation from Chernobyl meant that livestock and vegetation throughout Europe had to be destroyed. And while Ivan Boesky's insider-information scandal injured stockholders and companies directly, the resulting stock-market vagaries indirectly injured general consumers.

Until recently, no clear way existed to recompense the myriad victims of such situ-

ations fairly. During the 1970s oil crisis, the same problems arose with price gouging and oil companies colluding to evade energy price controls. Fortunately, those regulations, which ended in 1981, spawned a series of groundbreaking laws and lawsuits as the Department of Energy (DOE) and two federal judges drew on existing legal doctrines to address large-scale consumer injury.

In the 1970s, some companies sold "old oil" from existing fields as though it were the more expensive "new oil." One company that got into big trouble was Exxon.



In a 1983 settlement, it wound up paying a record \$2.1 billion for misrepresenting crude from its Hawkins field in Texas.

The Exxon suit was quickly overshadowed by the battle for the pot in the "Stripper Well" case, which involved several firms. Drawn "like flies to honey," in the words of Judge Frank Theis, claimants of every stripe fought over the more than \$1 billion in crude-oil overcharges that sat in a Wichita, Kans., account. And while lawyers,

Congress, and DOE grappled with ways to distribute the money, it drew interest.

Clearly, oil companies had overcharged refiners, who had overcharged distributors, who had inflated the wholesale price to retailers. The final victims had been U.S. consumers, but how could the government refund them without a record of who bought how much fuel when? And would refunds be worth the effort? "Does it make sense to send checks for \$2.50 if it costs government \$.75 or

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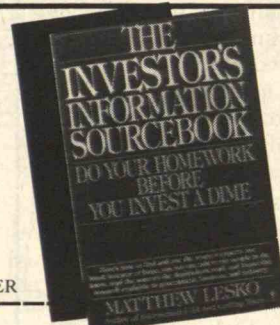
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**The 1970s oil crisis created lines at the gas pumps—and a legal tangle about how to reimburse the victims of illegal overcharges.**

more to process and mail each check?" asks Charles Hill, managing attorney for the National Consumer Law Center.

Sidestepping the questions of who was injured and by how much, U.S. District Court Judge Thomas Flannery settled the Exxon case by referring to a little-noticed congressional initiative of late 1982. That action had directed about \$200 million already in DOE's overcharge escrow account from earlier cases into five energy-conservation grant programs.

The Exxon judgment took the legal principle of "indirect restitution" and established it on a grand scale. Rather than reimburse injured individuals, the judge directed funds to other entities to act on their behalf. Flannery awarded the entire \$2.1 billion to state governments for use in energy-related consumer programs. Some of the better-known ones provide weatherization in low-income homes, assistance to low-income families to pay fuel bills, and energy renovations in schools and hospitals.

#### Billion-Dollar Questions

In the stripper well case, Judge Theis spent more time trying to determine exactly who was injured. In July 1986, he approved the stripper well settlement agreement, which continued the principle of indirect restitution through government programs. But taking a step beyond the Exxon judgment, the agreement set aside 20 percent for direct refunds to injured parties. Past major purchasers of petroleum are eligible for sizable refunds, but most private individuals find the refund too small to bother about. A large number of companies have already

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| <b>British Isles</b>                              | Airfare<br>2 Weeks, Hotel* | \$ 399  | \$ 804     |
| <b>Holland, Germany,<br/>Switzerland, Austria</b> | Airfare<br>2 Weeks, Hotel* | \$ 459  | \$ 976     |
| <b>Scandinavia</b>                                | Airfare<br>2 Weeks, Hotel* | \$ 499  | \$ 803     |
| <b>Tokyo</b>                                      | Airfare Only               | \$ 627  | \$ 851     |
| <b>Hong Kong</b>                                  | Airfare Only               | \$ 660  | \$ 850     |
| <b>Bahamas Cruise</b>                             | 5 Day Cruise*              | \$ 385  | \$ 585     |
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## MINI-TRENDS

paid out over \$1 billion under the agreement. Since that money has accumulated interest, consumers have received about \$2 billion, and DOE thinks the total could reach \$4 billion.

That brings us to the future. As Thomas Mann, deputy director of DOE's Office of Hearings and Appeals, suggests, "Ponder what would happen in a major environmental disaster, where citizens of many states were injured. Are there not also illegal trade practices that economically hurt large numbers of consumers in many different locales?"

The oil-overcharge solutions could be the answer. With the two-step stripper well formula, direct victims would get first crack at the illegal gains that a guilty party would be required to disgorge, and all consumers would benefit from remedies such as lower taxes or better services.

As with the oil cases, procedures for making direct refunds in antitrust, environmental pollution, and other cases will not be easy to establish. "It took the judge in the stripper well case nine years to determine a formula for direct and indirect injury, and to decide how an entity could qualify as a 'directly injured' party," Mann notes.

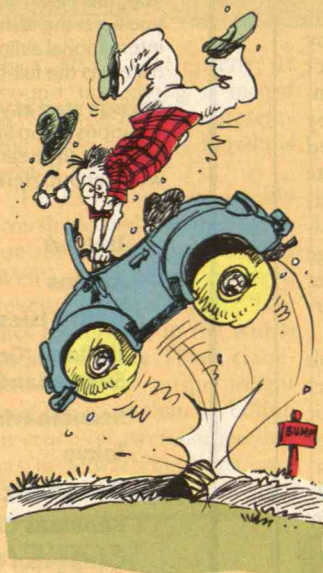
Nevertheless, he believes that the overcharge cases "are the only ones that have confronted the complications of modern economic life directly and honestly. In so doing, they have established a major precedent that will become increasingly important in the decades to come." □

FELICITY W. EVANS is a Washington-based consultant and free-lance writer specializing in technology and public-policy issues.

## DIVE, THEY SAID

If today's throwaway mania troubles you, consider *Alvin*, the nation's first research submarine. About once every other year, it is stripped to its titanium frame and upgraded with the latest technology. By now, little remains of the original sub, and although *Alvin* will soon be a quarter-century old, it is still up to date.

The craft set a record in March with its 2,000th dive to the ocean floor. Operated by Woods Hole Oceanographic Institution since 1964, the 25-foot, three-person submersible plunges about 170 times each year to depths up to 13,000 feet. *Alvin* first proved its value in 1966 when it located a hydrogen bomb accidentally dropped into the Mediterranean Sea.



## DUMP THE BUMP

"Speed bumps" are meant to slow drivers down, but University of Miami civil engineer William Fogarty thinks they are "ineffective, expensive, dangerous, and noisy." The Florida engineer says the bumps—molded asphalt ridges about 4 inches high and 12 inches long—actually encourage drivers to speed up. "The slower you go, the more punitive it is. If you do 30 or 40 miles per hour the shock absorbers take it up—you just get a ph-lumpp-ph—and then you're over it."

As an alternative, Fogarty proposes the speed *hump*, also 4 inches high, but 12 feet from front to back instead of 12 inches. As he explains, "the faster you go, the bigger the jolt." In addition, the slope of the hump can be less abrupt, so "pedestrians and bicyclists aren't tripping on it." Speed humps are used effectively in Europe, but there may be only one in the United States—in the parking lot of Fogarty's church.

## FLAT KNOWLEDGE

Almost half the fourth-grade children in the United States and Israel believe the earth is flat, say Alan Lightman, a research physicist at the Smithsonian Astrophysical Observatory, and Philip Sadler, a former science teacher. In *Science and Children*, they write that most children draw the earth as a giant pancake or a curved sky covering flat ground.

Lightman and Sadler have also found that teachers greatly overestimate students' knowledge. "Second-grade teachers believed that 95 percent of their students knew the earth was round when less than 5 percent of the students actually did."

## BREEDER TROUBLE

The Nuclear Information and Resource Service (NIRS) reports rising concern about France's Superphénix, the world's first commercial-sized breeder reactor. Recently, there have been reports of significant leaks of liquid sodium coolant from the fuel storage vessel. The leak reached 35 liters per hour at times. NIRS notes that "French scientists now believe it is unlikely the fuel storage vessel can be repaired, throwing the Superphénix's future—and that of future breeder reactors—in doubt."

According to NIRS, two organizations opposed to the breeder—Collectif d'Opposition à Superphénix in France and Earth First! in the United States—want the site of the 1992 Winter Olympics to be moved. The games are now planned for Albertville, which is 40 miles from the reactor, and Earth First! points to a threat of nuclear terrorism.





The organization is also fighting the breeder because it can produce weapons-quality plutonium.

### FUTURE SKILLS

The New Technology Committee of the American Institute of Chemical Engineers has examined the skills that future job seekers will need on a variety of technological frontiers. While principally designed to help develop curricula, the report is also intended as a career-mapping tool for students and as an aid to planners in professional societies, industry, and the government.

The core of the report is a series of "skills matrices" illustrating the technical background chemical engineers will need for careers in emerging areas, such as instrumentation and process control, health and safety, food, space systems, and materials. For example, the food matrix includes oceanography, air-pollution control, and public policy in addition to organic and physical chemistry, molecular and cell biology, materials science, and other traditional skill areas.

### ARCTIC HEAT

Electricity from the Arctic Ocean is both possible and free, say University of Alberta mechanical engineers Gerald Lock and Henry Stanford, Jr. They suggest that a generator based on ammonia could extract energy from the "warmth" of the water. First, the frigid air would cool the ammonia to a liquid whose temperature would be at least 40° Centigrade lower than the water. Next, a heat exchanger containing the liquid ammonia would be dipped into the water. This would vaporize the ammonia and provide the energy to run a steam-type engine.

As Lock and Stanford pointed out at a conference on offshore mechanics and arctic engineering, one of the nicest things about the idea is that the colder the outside temperature—and the higher the demands for heat and hot water—the more energy the system produces. In remote villages and research stations in large areas of Alaska, northern Canada, Greenland, and the Soviet Union, this low-tech, one-kilowatt generator could replace diesel power during the winter.

## The Rising Tide



**S**ince 1870 Cape Hatteras Light has warned ships away from North Carolina's treacherous Diamond Shoals. But in the intervening 118 years, erosion has removed 1,400 feet of beach from in front of the lighthouse.

Efforts to control the erosion started in the 1930s, when the Civilian Conservation Corps built an artificial dune the length of Hatteras Island. Eventually, efforts to keep sand between the lighthouse and the water included three structures on the beaches, artificial sea grass offshore, and the addition of nearly a billion-and-a-half cubic yards of sand. Oblivious, the ocean is now poised at the light's base.

In April 1987, Congress appropriated over \$4 million so the National Park Service could surround the light with a 23-foot-high octagonal wall. Although the rising sea and coastal erosion would

**Despite decades of protection from beach erosion, the Cape Hatteras Lighthouse was dangerously close to the shoreline in 1977.**

gradually cut the lighthouse off from the shore, it would be safe behind its fortification. However, some scientists now suggest that a more effective and cheaper solution would be to move the light.

The problem extends far beyond North Carolina. According to *Responding to Changes in Sea Level: Engineering Implications*, a National Research Council (NRC) report released last fall, climate changes may cause the sea level to be up to 11 feet higher by the year 2100, necessitating expensive coastal defense not only for beach cottages and lighthouses but also for the centers of major cities. The rise would most strongly affect areas where the land is simultaneously sinking, and that means the entire East and



Gulf coasts. "The thought of building an enormous dike around the eastern United States from Boston to Brownsville, Tex., is pretty horrendous," states Columbia University geologist Rhodes Fairbridge.

The rise would require modifying virtually everything constructed on the coast and in bays and estuaries. It would inundate low-lying areas of San Francisco, New Orleans, and other coastal cities; increase storm damage along streams and rivers that drain into the ocean; and cause more frequent flooding of highways, railroads, and airports. Moreover, a higher sea level would harm bridges and dikes, increase sedimentation in harbors, and erode seawalls and other protective structures. Saltwater would be forced into coastal aquifers used for drinking water, and pollutants from landfills near the coast could threaten other drinking water.

Property owners' first response to coastal erosion and sea-level rise has been to stand and fight—that is, to take the same questionable approach as the government has at Cape Hatteras Light. James Houston, chief of the Army Corps of Engineers' Coastal Engineering Research Center, says scientists' uncertainty about the extent of sea-level rise has discouraged action. For example, the corps, a major player in the coastal zone, "hasn't done much" to address the issue, he says.

#### Rising Concern

That situation is rapidly changing. *Responding to Changes in Sea Level* recommends far-reaching changes in coastal planning throughout the nation. Dodging the question of how much the sea level will rise, the report em-

phasizes the consequences of any significant change and provides some of the information that coastal planners and engineers need.

The NRC also echoes the call of many scientists for further research on sea-level rise and suggests that planners use the decade or so while choices are still open to change thinking about coastal-zone management. If planners acknowledge the threat, "There are an awful lot of things that you'd do differently," maintains James Titus, project manager for sea-level rise at the Environment Protection Agency.

One example of changed thinking comes from an NRC panel commissioned to study the Hatteras problem. The panel proposed that the park service put the historic 2,800-ton lighthouse on rollers and move it half a mile inland. Despite the technical difficulties this would entail, it could be a longer-lasting and cheaper solution than the octagonal fortress Congress has funded.

Similarly, the Corps of Engineers is reexamining its past planning for coastal projects to see if allowing for sea-level rise would have produced different recommendations. Dan Mauldin, chief of planning in the corps' Civil Works Directorate, hopes to issue new guidelines for future projects by the fall.

In New York City, the Port Authority of New York and

New Jersey runs numerous facilities vulnerable to rising sea level, including two bridges, two tunnels, four airports, and a subway line. Last fall, after asking six prominent scientists for advice, the agency began incorporating an allowance for a foot-and-a-half rise into its projects. For instance, improvements now underway in the drainage system at John F. Kennedy airport can accommodate such a rise without the flooding, delays, and closings that would otherwise result. Without such farsighted planning, the authority might

later have been forced to revamp the entire drainage system or build an additional one.

However, as Jack Clarke, coastal-zone management coordinator for Cape Cod, Mass., explains, the problem continues to be ignored in most places. "It's not something people see as an immediate threat, so they just put it aside, don't deal with it." Soon, they may have no choice. □

FRANK LOWENSTEIN, a freelance writer in Burlington, Vt., is an ecology graduate student.



**Erosion has exposed the timbers that supported the original jetties around Cape Hatteras Light.**



Millions of Americans suffer from the disease the German physician Alois Alzheimer first described in 1906.

## Attacking Alzheimer's

**T**wo to three million Americans suffer from the brain-deterioration syndrome called Alzheimer's disease. For some, mental decline begins in their forties and progresses rapidly, while for the majority it comes later and progresses slowly, and sometimes even plateaus. Regardless of the course the disease takes, little can be done for Alzheimer's victims and their families, beyond helping them cope. Not only is the emotional drain on families immense, the financial impact is astronomical. Direct expenses alone, such as medical care and accommodations, are estimated at \$40 billion annually.

German physician Alois Alzheimer first described the condition in 1906, but eight decades later doctors still can't say with certainty that a person has the disease, except after an autopsy. Often, diagnosing Alzheimer's is simply the result of ruling out up to 60 other potential problems, including strokes, depression, or drug reactions.

While a cure remains beyond the horizon, science's understanding of Alzheimer's is improving rapidly, raising hopes that accurate diagnosis may soon be possible. For example, one recent advance confirmed that Alzheimer's is sometimes inherited, and that genetic markers can be used to identify some people at risk. Molecular biologist James Gusella and his colleagues at Massachusetts General Hospital report that an unidentified gene, or genes, on chromosome 21 seems to be linked to familial Alzheimer's.

Interest in chromosome 21

is heightened by the fact that people with Down's syndrome have an extra copy of the whole chromosome. If such people live long enough, they almost invariably come down with symptoms remarkably akin to Alzheimer's disease.

Yet even if some Alzheimer's is genetic, the question is still open as to what actually causes it. Dr. Richard H. Myers, a neurologist at Boston University's Alzheimer Center, explains, "We need to capture the initial problem"—what goes wrong in the brain's nerve cells—or neurons—to bring on the syndrome. Unfortunately, by the time a patient is diagnosed with Alzheimer's, "the neurons we want to study have died. They died years ago."

### The Search for a Cause

Improved techniques to image the brain—such as positron emission tomography, which produces sharp pictures of very small areas of the brain—are aiding scientists in their search for a cause. Also, some laboratory work is concentrating on a thick protein called amyloid, which is found in brain cells and in the vessels supplying blood to the brain.

Dr. Peter Davies of the Albert Einstein College of Medicine in New York points out that, paradoxically, amyloid "is apparently identical in both normal aging and Alzheimer's disease." In Alzheimer's victims, however, researchers have found amyloid in tangled masses and globs. Whether these abnormalities cause or result from Alzheimer's has yet to be sorted out, although here,



too, says Davies, there appears to be a genetic tie to chromosome 21.

A team at the National Institutes of Health also suggests that something goes wrong with how neurons synthesize, degrade, or transport amyloid. Experiments with brain tissues have shown that the protein accumulates at the far ends of the axons, blocking normal function.

Davies adds that "amyloid is apparently derived from a larger protein that seems to be part of the normal nerve-cell membrane." To sort out what is happening, he is pursuing the recent discovery of a protein called A68. Davies has evidence that A68 appears normally in the brains of very young people but disappears after about age 2. It seems possible, he says, that the protein either helps young nerve cells grow and make their connections, or it helps clean up excess nerve cells after a brain stops growing.

But if A68 is accidentally made late in life, it might kill

off healthy brain cells. In fact, Davies has evidence that this substance may be greatly over-produced in brain cells that contain the amyloid tangles that are so characteristic of Alzheimer's. Moreover, he points to evidence that A68 shows up in cells even before they develop the tangles. This raises the possibility of developing an earlier, more accurate diagnosis of Alzheimer's by looking for signs of abnormal, late production of protein A68.

Despite these advances, Myers cautions that "there are some major questions to be answered." For example, he asks, "What proportion [of Alzheimer's cases] are familial?" And could there be familial forms of Alzheimer's not linked to a gene on chromosome 21? Fortunately, he believes "these specific questions do seem to be answerable." □

ROBERT COOKE is a science writer for Newsday in New York.



## Second Thoughts on the Massachusetts Miracle

FROM the pages of the *Economist* magazine to the hustings of the presidential campaign, the Massachusetts economy has become a symbol of successful technological innovation and industrial revitalization. For nearly 40 years, the state and the New England region were an economic basket case characterized by low wages and high unemployment. But since the late 1970s, rapid economic growth of 4 percent per year has created over 400,000 new jobs and given Massachusetts an unemployment rate below 4 percent, the lowest of any major industrial state. Little wonder people are talking about a "Massachusetts miracle" and pointing to the state's economy as a model for the nation.

Massachusetts' recent economic growth is certainly real, but the lessons to be drawn from it are not the ones most people think. The conventional explanations for the Massachusetts miracle are wrong. The prosperity of the state has engendered new inequalities. And unbalanced growth may lead to serious economic vulnerabilities in the years to come.

### The Exaggerated Role of High Tech

According to most accounts, two factors explain Massachusetts' success. An explosion of entrepreneurial activity, concentrated in the state's high-tech sector and fueled by the presence of world-class universities such as M.I.T., has led to rapid job growth. At the same time, an activist state government, serving as a broker for cooperation among business, labor, and the public sector, has promoted a good business climate and ensured that the benefits of economic revitalization are shared by all.

This description tells part of the story but not the most important part. Depending on how you define it, high-tech industry accounts for only 8 to 12 percent of total employment in the state. Between 1979 and 1986, only one out of six new jobs was in high tech. New jobs in more traditional sectors such as business services, construction, health, and education



*The  
Bay State's  
fast-growing economy  
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the nation that  
some think.*

were far more numerous.

Much of the high-tech job growth that has occurred is due less to the activity of dynamic entrepreneurs than to that of big government—specifically, the Defense Department. At least one-quarter of the new high-tech jobs created in Massachusetts since 1979 have depended either directly or indirectly on Department of Defense procurement.

Finally, the state's low unemployment rate is due less to rapid job creation than to the unusually slow growth of its labor force. Surprising though it may seem, more people are leaving Massachusetts than moving to it—including thousands of graduates of the state's colleges and universities. And when they go, they tend to leave the New England region altogether. Among the usual reasons cited for this phenomenon are the region's long winters,

historically high energy costs, and currently record-breaking housing prices—the highest in the nation. Whatever the reasons, relatively fewer people want jobs in Massachusetts than elsewhere, which makes achieving full employment a lot easier.

### Fast Growth but Rising Inequality

What about state government efforts to attract investment to depressed areas and match workers to jobs through innovative job-training and welfare programs? Massachusetts efforts in these areas have been among the most comprehensive in the nation. But despite these initiatives, the benefits of the state's revival have not been shared equally.

The regional distribution of job growth has been highly uneven. Nearly all the new high-tech employment is concentrated within a relatively small part of eastern Massachusetts. And according to one estimate, three-fourths of *all* the new jobs created in the state between 1975 and 1986 were located within the Boston metropolitan area. Beyond that region, average wage rates are still well below the U.S. standard. In reality, the Massachusetts miracle remains largely a Boston miracle.

What's more, as the economic expansion proceeds, some people are falling even farther behind. Between 1979 and 1986 the share of total annual wages and salaries going to the poorest fifth of the state workforce declined, while that going to the highest fifth—especially the top 5 percent—rose dramatically, reflecting a national trend.

### The Danger of Unbalanced Growth

From 1979 and 1984, it looked as if the Massachusetts miracle was affecting the entire economy—including manufacturing, wholesale and retail trade, services of all kinds, construction, and finance. But more recent evidence suggests that the state's economy is becoming dangerously unbalanced. Since 1984, growth in manufacturing has halted completely. Indeed, manufacturing, including high tech, has actually *lost* nearly 90,000 jobs since 1984, and more than 200 plants have closed their gates. Most service industries are no longer creating jobs at a pace faster than one would expect from national data. Construction, finance, insurance, and real

*Continued on page 78*



BENNETT HARRISON IS PROFESSOR OF POLITICAL ECONOMY AND PLANNING AT M.I.T. AND THE CO-AUTHOR OF THE DEINDUSTRIALIZATION OF AMERICA.



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—George Bernard Shaw

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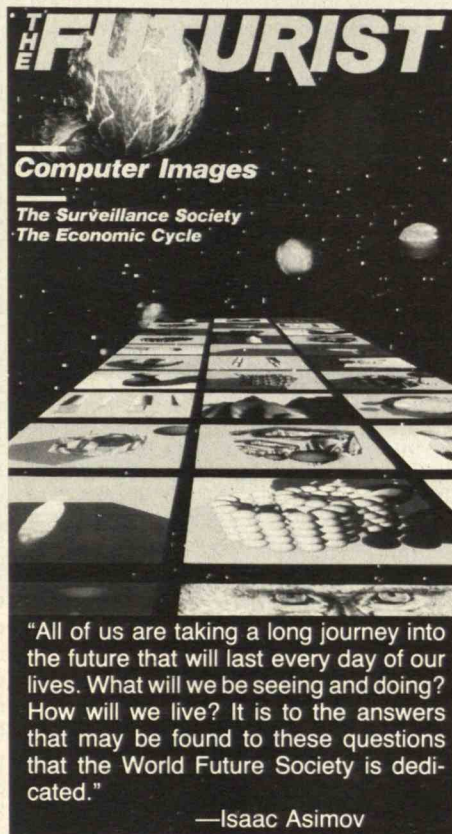
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# Why Technology Doesn't Kill Diversity

**A**t a recent cocktail party, I fell into conversation with a woman who had just returned from Southeast Asia. It was so disappointing, she explained to me. "Why, Bangkok is getting to look just like St. Louis!"

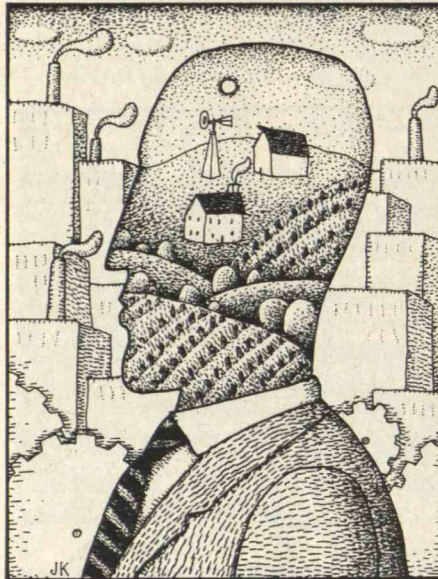
My disgruntled acquaintance was voicing a widely held opinion: as the world becomes more technologically advanced, cultures increasingly come to resemble each other. Homogeneity appears to be a price we pay for better shelter, sanitation, and transport, and for the dissemination of refrigerators, radios, and washing machines. It is only natural to want health and comfort for all, but isn't it a shame—or so goes the complaint—that this obliterates the differences that have distinguished peoples and their habitats for centuries.

The reasons for the propagation of sameness are easy to identify. Efficient engineering solutions look the same in any language—thus bridges, skyscrapers, and automobiles tend to resemble each other wherever they appear. Manufacturers in the most technologically advanced societies export their mass-produced merchandise to less developed lands, so tractors, locomotives, and computers travel in their original shapes and patterns—as do tourists in their Western clothes. Technical standards for tens of thousands of items from nuts and bolts to mattresses promote efficiency and economy, and so are adopted internationally. Western cultural traits are spread by movies, magazines, and television—making Mickey Mouse and rock music recognizable around the globe.

And yet, while I concede the validity of these facts, I also believe a powerful counterforce is at work, the effects of which have been too little noted. Our elegiac concern for the death of diversity may prove misplaced.

## The Return to Tradition

Rapid technological change and foreign influences provoke resistance. Modern life, much like medical inoculation, contains within itself the germs of anti-mod-



*Technological  
society doesn't eliminate  
local traditions and  
personal choices;  
it encourages  
them.*

ern sentiment. People in many nations are returning to once discarded traditions and battling fiercely to defend local customs. In Iceland, the purity of the local language is protected by a special state commission. In some Islamic lands the adoption of Western dress and customs is punished by severe penalties. In every corner of every continent, one finds renewed pride in traditional folkways, and government and private sponsorship of native dress, dance, architecture, and crafts.

Paradoxically, technology lays the foundation for such developments. As the ultimate source of wealth and leisure time, technology creates the space for introspection and consideration of alternatives. It also provides the defenders of tradition with the same educational and propaganda tools that helped contribute to change in the first place. On local radio stations and cable television, for example,

one finds announcements about quilting bees and ethnic festivals along with news of the latest movies and rock concerts.

Granted, such resistance to homogeneity is only partly effective. Having to defend and encourage local traditions may be the first sign of their decline. It may prove as impossible to halt the spread of bluejeans and Sony Walkmans as it is to stop the proverbial rising tide. Nevertheless, the impact of technology on local customs is not nearly as uniform as we tend to think.

## New Realms of Choice

Moreover, the advance of technology in itself creates new opportunities for diversity. A characteristic feature of technologically advanced societies is cheap transport. Another, which stems from the division of labor, is a complex and greatly varied job market. A third is the opportunity for many individuals to accumulate capital, albeit usually in modest amounts.

What this means is that the average citizen can get a job, save a bit of money, then travel to another place and get another job, or even embark on a new business venture. Such mobility is often derided by critics of technology who claim that it contributes to footlooseness and loss of roots. They claim that the freedom technology brings is illusory, since wherever one goes the landscape is liable to be blemished by the same shopping centers, the airwaves tainted by the same radio and TV shows.

Yet there is a good deal of evidence that mobility contributes not to sameness but to diversity. A recent *New York Times* article described the rebirth of small food-processing ventures in New England. Across the nation and particularly in the Northeast, people are resisting mass-produced, chemically treated foodstuffs and turning to more varied regional products. This is an interesting example of how large-scale advanced technology does not perpetually take over.

What I find most striking about this example is the people themselves, individuals who moved from one place to another to lead lives different from those in which circumstances had placed them. A former computer service manager from Manhattan grows hydroponic vegetables in Lakeville, Conn. An Ohio schoolteacher and New York City tugboat captain raise lamb on a farm in Putney, Vt. A Canadian car-

*Continued on page 78*



SAMUEL C. FLORMAN, A CIVIL ENGINEER, IS THE AUTHOR OF *ENGINEERING AND THE LIBERAL ARTS*, *THE EXISTENTIAL PLEASURES OF ENGINEERING*, *BLAMING TECHNOLOGY*, AND *THE CIVILIZED ENGINEER*.



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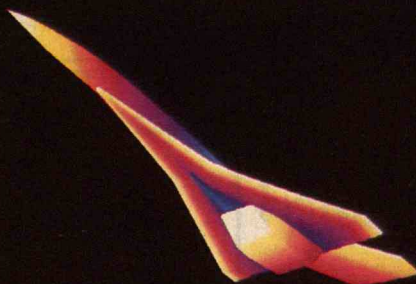
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# DOES THE SPACE PLANE HAVE THE RIGHT

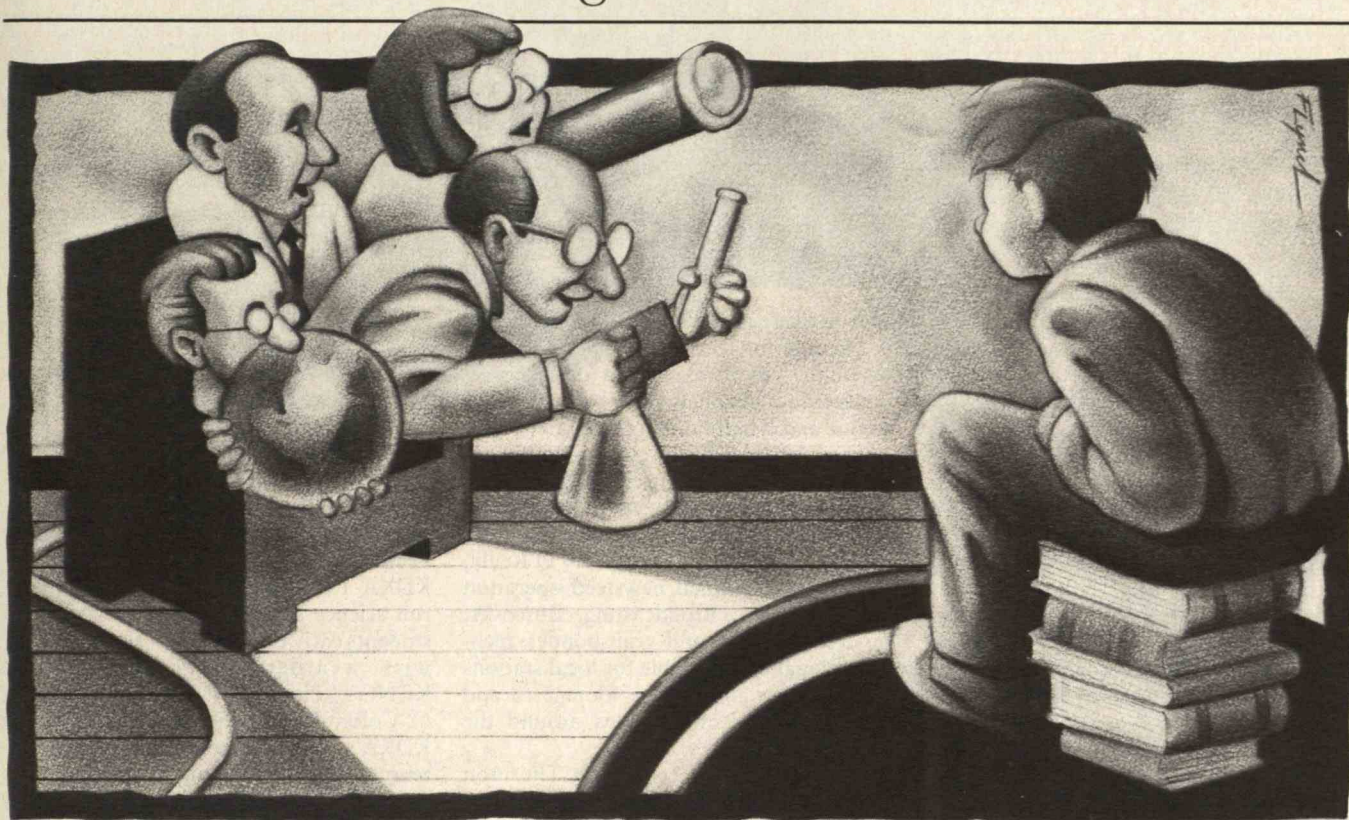




## FORUM

BY FRED JEROME

# TV or Not TV: Tuning In to Science



If you had any doubts about the extent of America's ignorance of science, consider the results of a survey of newspaper editors—presumably a well-educated group—conducted last fall by Oberlin College biology professor Michael Zimmerman. Only 51 percent of the 534 respondents disagreed with the statement “Dinosaurs and humans lived contemporaneously.”

Plans and projects to improve formal science education abound these days, and as election day nears we will, no doubt, hear still more. The problem is that most Americans are long gone from school, and their “continuing education” takes place in front of the TV set. Even students spend more time being taught subliminally by TV than in classrooms. According to the Nielsen reports, from 1983 to 1987 American households watched an average of more than seven hours of television a day.

FRED JEROME is executive vice-president of the Scientists' Institute for Public Information. Last December his organization hosted a meeting of more than 40 leading scientists and television executives to discuss science coverage on TV.

**S**cientists  
and engineers  
need to reach out to  
commercial-TV  
news directors.

And a 1987 Roper survey found that a majority of Americans get all their news from television.

More than any other medium, commercial television molds the American mind. For example, newspapers had run numerous articles on the African famine, but it wasn't until vivid pictures of starving Ethiopian children appeared on the evening news that the issue became a priority in the collective conscience of the United States.

Any successful effort to overcome scientific ignorance in this country must include the news on the tube. Whether the

story focuses on the race to conquer AIDS, or the superconducting supercollider (SSC) and its budget battles, most of the public remains ignorant of science issues affecting their pocketbooks and lives unless they learn about the topics through commercial TV. Yet the science and commercial-television communities have made little effort to work with each other, arguing that science just can't be presented well on television. But the stakes are too high to leave it at that. Let's examine these communities' concerns about the difficulty of presenting science on TV.

### Science Is Complex? Try Football

*Science is too complicated for the average commercial-TV viewer to follow.*

Yes, science is complicated, but so are other subjects that are presented successfully on television. What could be more complicated than a professional football game, with 22 humans simultaneously moving in different directions according to an unannounced plan that changes on each of more than 100 plays in a game? Tens of millions of Americans follow, understand, argue fiercely about, and above



all, thoroughly enjoy this complex exercise week after week.

TV technology—including slow-motion playback and animation—has the potential to make science understandable and fun for the general public. TV helps millions to understand the collision of two high-powered front lines in football; it could do the same for the collision of two high-powered energy beams in the SSC.

*But (the typical argument continues) football has plenty of dramatic action—good “visuals.” Science is usually presented by “talking heads,” a device that comes across as dull on TV.*

Science and technology lend themselves to lively, colorful animation and photography, from the fascinating movement of the tiniest molecules and subatomic particles to the brilliant stars in the vast reaches of outer space. Thousands of film clips and videotapes have been produced that provide this excitement. The problem is that most television employees don't know where these pictures are or how to obtain them. To address this basic need, in April the Scientists' Institute for Public Information launched a telephone-referral service that helps TV journalists locate videotapes available from universities, government agencies, and the like.

Well-thought-out presentations are also critical. Rather than recreating the unimaginative science classes taught in most schools—dehumanized and loaded with rote rather than reasoning—TV producers need to imbue viewers with the drama and tension and controversy inherent in the challenge of scientific exploration. This could even include encouraging viewers to participate in simple experiments. (After all, Julia Child does that.)

If television can make hairsprays—and Wall Street—interesting, it can do the same for science. As NBC's Reuven Frank, considered the father of the TV documentary, recently pointed out, “The networks pay huge salaries to attract the top creative talent in the world . . . [They have] the ability to make things interesting to an audience.”

#### Local News: The Way to Go

*We aren't talking about documentaries or football games, however. Since network news has only 22 minutes to cover the world, whatever science reports are squeezed in are likely to be distorted. And with all the competition for ratings,*



*they're likely to be sensationalized as well.*

The solution to these problems may well lie in the recent expansion of local TV news. Most channels now have as much as one and a half hours of local news preceding the network's coverage. Assignment editors and producers are hungry for material to fill this “news hole.” “Local stations have the luxury of allotting more time to a good story,” says Terry O'Reilly, head of the national newsfeed operation at Westinghouse Broadcasting. Moreover, modern satellite and transponder technology makes it possible for local stations to broadcast and receive footage to and from hundreds of locations around the country.

Still, former RCA chairman Thornton Bradshaw cautions that it won't be easy to get any—let alone accurate—science on many local news programs. “The local news people are scared of science because they don't know anything about it.”

The key to turning around this situation is, as the telephone company says, to “reach out and touch” local news people. The scientific community should invite TV journalists to see what projects they're working on, and show these visitors around the lab or computer room. Scientists and technologists should explain why they are excited by their work, and discuss how to transmit that feeling through TV without sensationalizing the story. In other words, scientists and TV journalists should get to know each other.

Recently, some institutions have formalized this process by launching or expanding their production of science videotapes. For example, Cornell University has added its own satellite transmission facilities. Other institutions, like Stanford Medical School, have assigned one person in their public information office the specific job of getting to know local TV people.

#### New Interest for Science Stories

It will take some effort, but increased com-

munication could result in better science stories with less hype, and in more pieces that look at scientific fields other than medicine and health. There are now signs that local news shows are increasingly interested in more extensive science stories. In part, local producers have noted the recent popularity of expanded medical coverage on TV news. Producers in communities with large high-tech populations have also started to recognize scientific interest there. And parents concerned about local school systems' failure to inspire enthusiasm for science have pushed for science coverage.

A number of local stations have tried science features in their evening news programs. Audience feedback has been excellent. For example, KGO-TV in San Francisco, KCNC-TV in Denver, and KDKA-TV in Pittsburgh tested limited-run science series aimed at teachers and students early this year. KGO's “Starwise” with weatherman Peter Giddings, KCNC's “Physics 4 Fun” with University of Colorado physicist John Taylor, and KDKA's “For Spacious Skies” with meteorologist Brian Sussman were cooperative ventures with local school districts involving tens of thousands of elementary schoolchildren.

The latter became a weekly feature after its initial success. Also on a weekly basis, KSL-TV in Salt Lake City features science reporter Ed Yeates in a segment called “Shades of Gray” that focuses on unproved yet plausible explanations for unusual phenomena. And WCVB-TV in Boston includes a weekly “Science Digest” segment that Potomac Story Network syndicates to about 30 stations around the country. Harvard physicist Michael Guillen, who presents the program, also did a half-hour special last year on chaos theory—a show that beat out a lineup of sports programs in ratings.

It's significant that ABC—WCVB's network affiliate—expanded Guillen's role by asking him to do a weekly science spot on “Good Morning America.” Frank Stanton, former president of CBS, thinks that once a few of the local stations receive recognition for producing good science news, the phenomenon is likely to catch on. Like the TV news doctor, regular science coverage “may eventually even become part of the network news,” he says.

Help start this process. Get on the phone to channel 2, 4, 5—or whatever—and invite its news director to lunch. □



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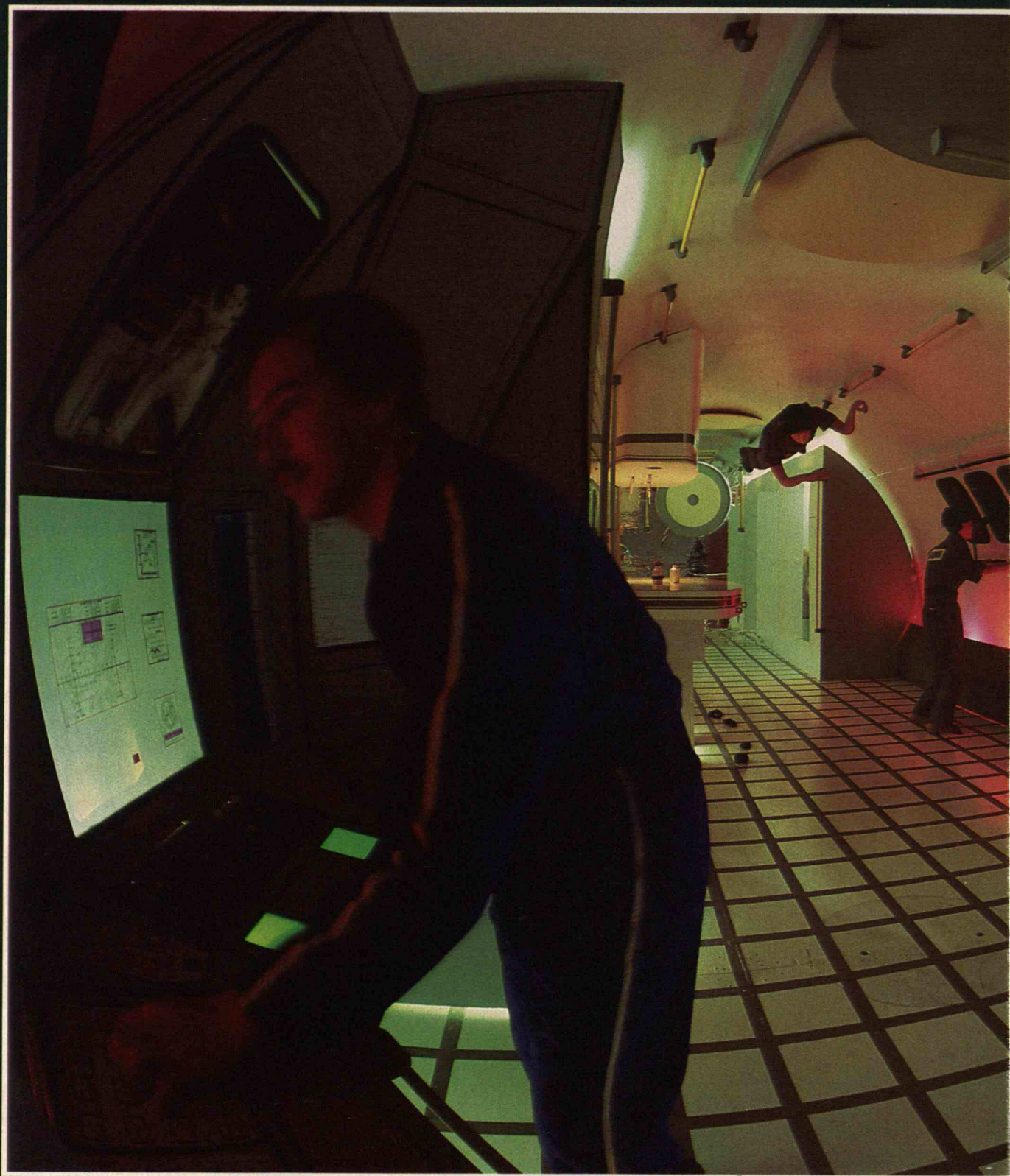


PHOTO: BRUCE FRISCH





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*NASA awarded construction contracts for a U.S. space station last year. The venture is a carefully thought-out and necessary step for the space program.*

## The U.S. Space Station: A Quarter-Century of Evolution

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BY PHILIP D. HATTIS

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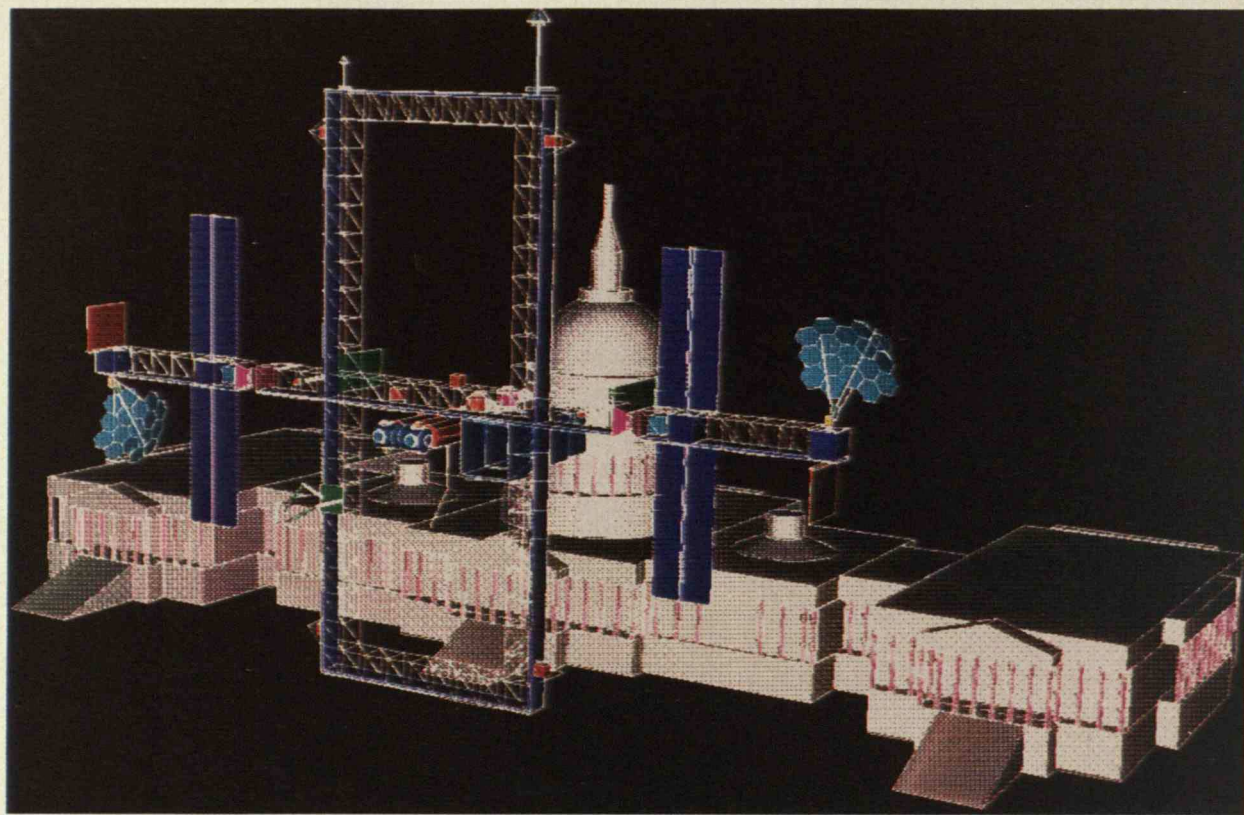
**F**OR at least a century, scientists have dreamed of placing human beings in laboratories circling the earth. In 1869, the astronomer Rev. Edward Hale, writing in the *Atlantic Monthly*, proposed a spherical "brick moon," and in 1952, a series of illustrated articles in *Collier's* portrayed a torus 250 feet in diameter that would spin to simulate gravity for its passengers.

On a down-to-earth level, federal agencies first proposed a space station in the 1960s, soon after it appeared possible to launch humans safely into space. Since then, few other major government programs have undergone as much conceptual and developmental analysis. Even fewer have faced scrutiny from as many groups of outside experts.

As a result, NASA's current concept of the station's design and purposes has been carefully crafted. The project should meet the requirements of both expected users and congressionally mandated applications, while a deliberate pace of development should limit the demands for resources.

Important challenges for the space program remain, but the nation has thoroughly reviewed its options for future civilian space goals, including scientific and com-





**The U.S. space station would be roughly the size of the U.S. Congress, which is where decisions about the project's fate currently rest.**

mercially valuable ventures. The pursuit of any of the major options requires not only advanced orbital facilities, but also the permanent presence of human beings in space. The planning process has lasted long enough, with reviews and compromises covering every legitimate concern. The time has come to move toward developing the nation's vertical frontier by building the station.

### **Skylab: The First U.S. Space Station**

One of the first concrete steps toward a U.S. space station came from the military. As early as 1962, the Department of Defense (DOD) began exploring how hardware from NASA's two-person Gemini capsule could serve military needs. DOD sought to place the Gemini program under its own banner, but backed off under congressional and public insistence that Gemini remain civilian. Instead, DOD initiated the Manned Orbiting Laboratory Program (MOL) to

consider a Gemini capsule with an attached laboratory. With a planned 30-day operational life, the lab would evaluate how personnel in space could contribute to military needs. Congress authorized preliminary MOL studies in 1963, and two years later President Lyndon Johnson formally approved development of the lab.

However, all work on the MOL ended in 1969. Budgets, project goals, and Vietnam War costs all had soared, but even more important, the MOL had been superseded by the more sophisticated Apollo Applications Program (AAP). Begun by NASA to broaden and extend the uses of the Apollo moon program's hardware, AAP was expected to make solar and terrestrial observations and evaluate how humans respond to extended weightlessness.

AAP evolved into the *Skylab* laboratory, an early version of the space station. Orbited unmanned as a huge, fully outfitted laboratory in 1973, *Skylab* hosted three missions of three astronauts each for stays of 28, 59, and 84 days. Hopes that the upcoming space shuttle would service *Skylab* faded when the shuttle program ran behind schedule and the lab's orbit decayed faster than predicted. The abandoned *Skylab* fell to earth in 1979.

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*Since the late 1970s,  
the space station, like U.S. space policy in general,  
has centered on the shuttle program.*

## A Shuttle-Era Space Station

By the late 1970s, U.S. space policy in general centered around the growing shuttle program. For the space station, this dictated a building-block approach to construction, since shuttle payloads were limited to 60 by 15 feet and 65,000 pounds. Most space-station concepts were much larger.

From mid-1979 to the end of 1982, two NASA research establishments, the Marshall Space Flight Center in Huntsville, Ala., and Houston's Johnson Space Center, investigated space-station designs that would use shuttle-transported components. Without inter-center design coordination, each site's proposals emphasized its own activities.

In the 1970s Marshall housed work on large, automated space platforms and low-gravity material processing. Its proposal called for a platform that would gradually evolve into an occupied facility with a single pressurized module. Only later would the facility become a full-scale, permanent station with many pressurized modules. Although the early objectives were cost-effective, the scope of this concept was limited. Proposed applications related mainly to astronomy, evaluating how large structures behave in space, and monitoring the physical properties of materials processed in low gravity.

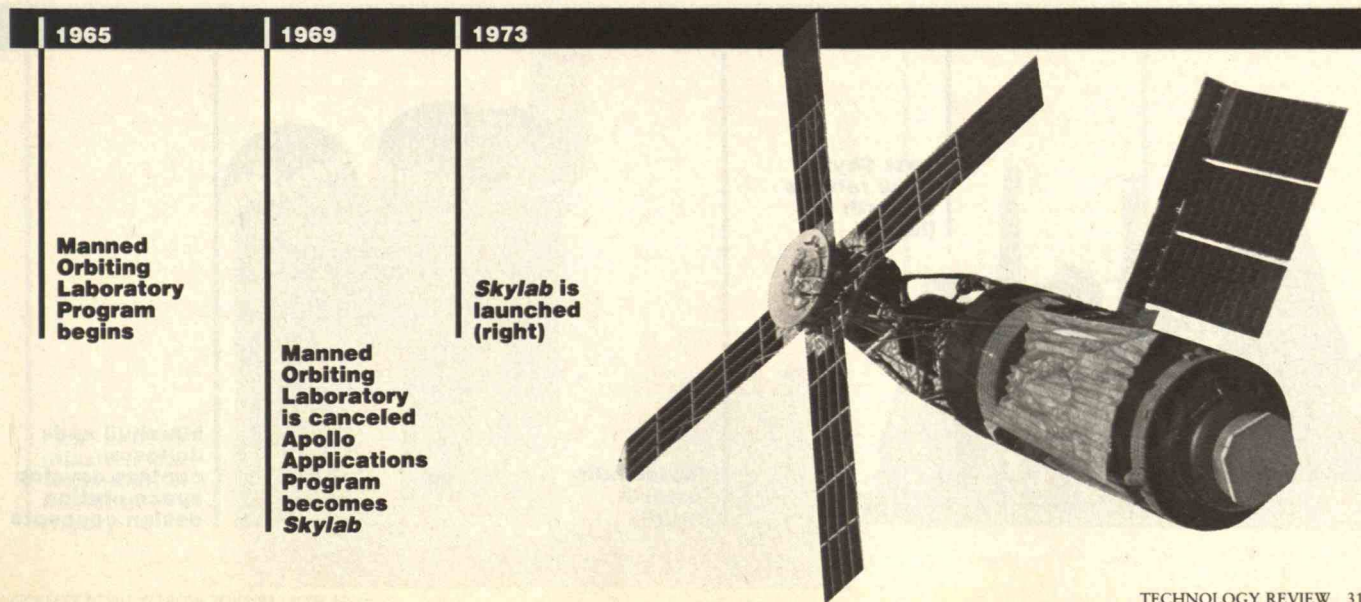
By contrast, Johnson has always emphasized astronaut projects, and its Space Operations Center (SOC) presumed a permanent capacity for human inhabitants in the first stages. In addition to fulfilling

most of the Marshall platform's uses, the SOC could be a refueling and repairing base for satellites and a site for building large space vehicles.

Faced with these competing ideas, in 1982 NASA commissioned the Space Science Board (SSB) of the National Research Council (NRC) to survey the requirements of potential users. The study concluded that, taken alone, anticipated science missions wouldn't require personnel on a station before the year 2000. However, the SSB decided that many science projects might benefit from a station capable of repairing, refueling, and upgrading automated satellites.

The SSB also warned that a facility designed for several different purposes could present conflicts. Many science projects require minimal disturbances and contamination, but this would be impossible on an occupied vehicle. For example, vibration from satellite repairs could hamper sensitive low-gravity experiments. Nevertheless, the board advised that a multi-purpose space station could serve space-science activities if resources to keep them viable were sustained.

Moreover, a station that housed a wide range of smaller projects could help scientists identify what large-scale specialized facilities should follow. A permanent laboratory staffed by astronauts from the start would let NASA evaluate prototypes of novel earth-orbit systems and operations. These prototypes could test out advanced observatory concepts; experimental manufacturing, construction, and re-





# *Reagan's endorsement in 1984 established an enduring role for space flight as U.S. policy.*

pair techniques; and closed-cycle, life-support systems for manned exploration of the planets.

Supporting the SSB conclusions, other studies showed that many goals not directly served by a space station would be indirectly served. For example, some satellites for commercial communications or military surveillance require a geosynchronous orbit. At 22,300 miles altitude, this is far above any intended space-station orbit. But future large geosynchronous satellites might be assembled and checked out in a low orbit.

## **Refining the Design**

On the basis of these considerations, NASA opted for a multi-purpose station at an expected cost of \$8.5 billion. When President Reagan endorsed the idea during his 1984 State of the Union Address, a permanent space station that would be operational within a decade became a national goal. The president's advocacy, sought for two years, represented a breakthrough, because it recognized the importance of the station to expanded space operations. His endorsement established an enduring role for space flight as official U.S. policy and was necessary to solidify political backing for budget proposals.

Anticipating the president's support, NASA had established a group in late 1983 to develop station concepts. Several months later, after considering several configurations, NASA adopted a "power tower" as the baseline design on which to award preliminary

study contracts. The power tower was basically a long, slender mast pointing away from the earth, with modules lined up along it.

Projected to fly at an altitude between 250 and 310 miles, the power tower combined the best features of Marshall and Johnson proposals. It would be both an astronomical and an earth-resources observatory. It could also be an engineering test facility for constructing and controlling larger space structures, a laboratory for low-gravity biological and material-processing studies, and a satellite-repair and fueling depot. Moreover, reflecting the international cooperation called for in Reagan's address, the pressurized modules would include a derivative of *Spacelab*, a shuttle-dependent, multi-purpose orbital lab built by the European Space Agency (ESA).

Foreign interest in participating in the U.S. space station was high. ESA wanted to enhance *Spacelab*'s capabilities as part of a proposed program called Columbus, which could be directed largely toward participating in the U.S. space station. Canada sought to develop satellite-servicing facilities for the station, and Japan proposed developing its own laboratory facility—to be attached to the station—for material-science studies and basic space research.

To accommodate SSB recommendations on space-science needs, the baseline design supplemented the power tower with two platforms that would be attended only rarely by humans. A large polar-orbiting satellite—which the shuttle would service—would provide data on earth resources and the atmosphere.





# *The Challenger disaster has meant increasing congressional involvement in the space-station program.*

A separate satellite flying close to the station—the “co-orbiting platform”—would provide a place to conduct experiments unaffected by motion and contamination from the station.

Very soon, objections to the power-tower approach appeared. Critics said that the apparatus provided too few places to mount additional equipment, and that the station’s once-per-orbit spin would have too strong an effect on the pressurized lab’s environment. NASA responded quickly, and in late 1985 the agency adopted the current “dual keel” concept. In this design, two long towers would form a double backbone held together with three horizontal braces. Pressurized modules would be mounted near the middle of the dual keel.

By putting modules closer to the center of the station’s mass, this design would limit disturbances to low-gravity experiments. Extra mounts for experiments could be put on the upper and lower horizontal braces. Also, a dual-keel station could be expanded more easily to service, assemble, and fuel vehicles for geosynchronous and extraterrestrial activities. For example, it could accommodate large, temperature-controlled hangars for constructing and checking out future moon and Mars transports.

With this refined concept in hand, NASA expected to award final contracts in 1986 for designing and building the space station. The agency budgeted 14 shuttle launches to assemble the station, excluding scientific payloads but including modules supplied by prospective international partners.

## **The Challenger Disaster**

The loss of the *Challenger* space shuttle in January 1986 has had repercussions on all military and civilian space activities. For the space station, it has meant increasing congressional involvement, resulting in changes in both design and operational requirements.

In June 1986 James Fletcher, NASA’s new administrator, took a step toward overcoming institutional problems identified in the shuttle program. He instructed a committee headed by former Apollo program director Gen. Sam Phillips to propose management improvements in the space-station program, and the committee responded by recommending that the technical coordination among NASA centers be moved to a separate, centralized facility. The intent was to eliminate the inter-center communication gaps that had contributed to the decision to launch *Challenger*.

NASA established this central facility near Washington, D.C. However, that decision was not universally popular on Capitol Hill—a reflection of congressional attention. Resistance was particularly strong in the Texas delegation, since the management work had previously been planned for Johnson. But the Texas opposition did not prevent the move.

More important, appropriation legislation began to include specific design requirements based on latent political and technical concerns. For example, Congress mandated an emphasis on material-science

1981

First shuttle mission, the *Columbia*, is launched (right)



1982-1983

Space Science Board assesses space-station plans

1984

Reagan endorses NASA space station



*To contain expenditures,  
Congress required NASA to reconsider its timetable  
for manning the station.*

and life-science payload capabilities to assure U.S. leadership in the relevant technologies. This, in turn, caused Congress to specify minimum power-production levels to guarantee that there would be adequate energy for power-hungry material-science studies. Congress also tried to protect a U.S. competitive edge in the key technologies by restricting use of international modules for material science.

Pressures on overall federal expenditures induced Congress to deepen its scrutiny of cost projections. The accident renewed a heated debate about the relative merits of manned and unmanned space activity and reinvigorated old arguments that protecting human crews placed too great a drain on resources. As a result, Congress required NASA to reconsider its commitment to continuous manning of the station during early operations.

As NASA engineers learned more about the causes of *Challenger's* destruction, they proposed changes that would put new limits on future shuttle performance. The shuttle's main engine thrust would be augmented later than previously planned, and the redesigned booster would be heavier at launch. Both changes would reduce the shuttle's payload capability.

Newly heightened safety concerns about manned flight led the astronaut office to review planned station operations. Its study noted that extended shuttle groundings were possible, which meant the program needed an alternative way to get station inhabitants back to earth quickly. Moreover, assembling and

maintaining the station would require excessive extravehicular activity (EVA) for astronauts.

These post-*Challenger* considerations did not alter NASA's commitment to a dual-keel station, but they raised the required number of shuttle flights to 17 to 19, as opposed to the previous 14. Clearly, the new design objectives, safety requirements, congressional restrictions, and budget limits would require replanning the assembly process. NASA organized another panel.

### Phased Construction

The Critical Evaluation Task Force (CETF) met at NASA's Langley Research Center at the end of summer 1986 and included key technical people from all the agency's research facilities and technical disciplines. The CETF evaluated proposals for designing and constructing the space station, aiming to retain existing scientific and technical goals, operational objectives, and dual-keel design features as much as possible. But the CETF also examined possible major alterations, including separating the project into distinct steps. This would spread out shuttle flights and reduce the per-launch mass requirements.

In October 1986, the CETF recommended developing the space station in two phases. A relatively modest Phase I station would include the central horizontal truss of the dual-keel model, plus all pressurized modules. Congressionally mandated low-gravity material-processing and life-science investi-

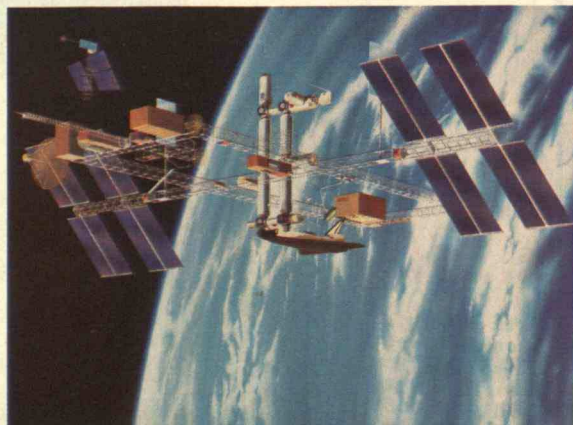
1984

**"Power  
tower"  
configuration  
released  
(right)**



1985

**Design  
study  
contracts  
awarded;  
"dual keel"  
adopted  
(right)**





## *NASA addressed mounting budget pressures by separating the space-station plans into two phases.*

gations would be fully supported. The CETF also advised connecting modules with voluminous pressurized chambers instead of small pressurized passageways. Such chambers would enclose systems that were previously expected to be outside the pressurized modules, thereby enhancing safety by reducing EVA requirements for maintaining the system.

The CETF initially projected that Phase I would require 14 shuttle flights, although by October 1987 the estimate rose to 19 flights spread over three years. This included 13 flights for assembly, 2 to outfit the station with laboratory equipment, and 4 resupply flights. The station would first be used on the sixth shuttle flight, tended by astronauts only while the shuttle was present. Permanent occupation would begin with the ninth flight.

The CETF believed that six additional assembly flights would get the full dual-keel station in operation (Phase II). Interspersed with resupply flights for the operating station, these would probably span another two to three years.

To address mounting budget pressures while maintaining the possibility of eventually pursuing all program goals, NASA decided to accept the CETF phases as separate options. Phase II funding approval would be sought only after substantial progress toward launching Phase I.

By summer 1987 NASA finally asked potential contractors to submit design and development proposals, with directions to bid on each phase separately. A few weeks later, NASA awarded Grumman

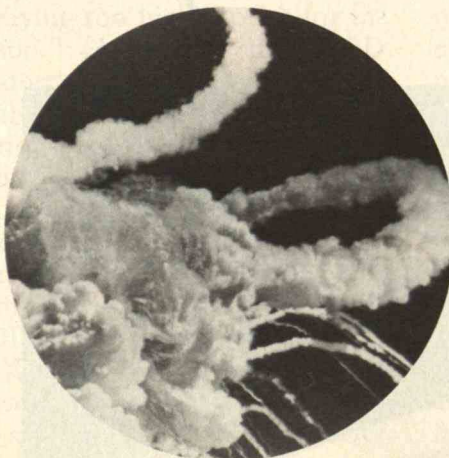
the "system engineering and integration support" prime contract, fulfilling a Phillips committee recommendation that the agency select an oversight contractor whose sole purpose would be to thoroughly review the very complex assembly, testing, and verification process. At the same time, NASA selected Lockheed as the prime contractor for ground-based computer software.

### **The Pivotal Review**

However, NASA was still not ready to select the prime contractors for building and assembling the station. As a result of the CETF efforts, the Phase I design met the technical constraints of post-*Challenger* guidelines, while adhering to congressional mandates. But it was significantly less appropriate for other advocated applications, since some external mounts for observatories and space-structures experiments would be initially sacrificed. By mid-1987, an independent review of the current program and cost estimates seemed technically warranted and was essential to satisfy congressional concerns about NASA's technical biases and cost projections.

For that purpose, the Reagan administration and NASA asked the NRC to assemble another blue-ribbon group of scientific experts. Congress and the administration agreed that this panel's recommendations would be pivotal to the fate of the 1988 space-station budget allocation—and possibly the program's survival.

**1986**



**Space shuttle Challenger explodes at launch (right)**

**1986**

**Phillips Committee recommends management changes; Critical Evaluation Task Force recommends phased buildup**

**1987**

**Systems, engineering, and support and software contracts awarded**



*The space station could be paid for in two years if the nation funded it at the same level as the mid-1960s.*

The NRC group, headed by former NASA deputy administrator Robert Seamans, released its report in September 1987. It endorsed the Phase I station as a thoughtful compromise and a good first step with reasonably well-understood applications. The NRC cost estimate of \$14 billion to \$18 billion agreed with budgets previously submitted by NASA and the administration.

The NRC cautioned that the estimate included primarily costs unique to the program, an approach consistent with usual practice. The one major exception was money for a crew emergency return vehicle (CERV) to be stored at the station. This addressed a ground rule set when CETF was established that NASA needed a generic backup vehicle. The NRC panel also called for an unmanned launch vehicle to lessen demands on the shuttle fleet and supply the station in case of shuttle groundings.

On this basis, the panel identified the total resources needed to complete Phase I, including such items as shuttle operations and civil-service salaries that would otherwise be applied to different programs. The cost was raised to \$21 billion to \$25 billion.

As large as those figures seem, they represent the total investment the nation would have to commit over a decade to expand and extend U.S. manned-operations capability. Taking inflation into account, the entire cost could be paid in two years if the nation funded the space station at the same level as the space-operations development of the mid-1960s.

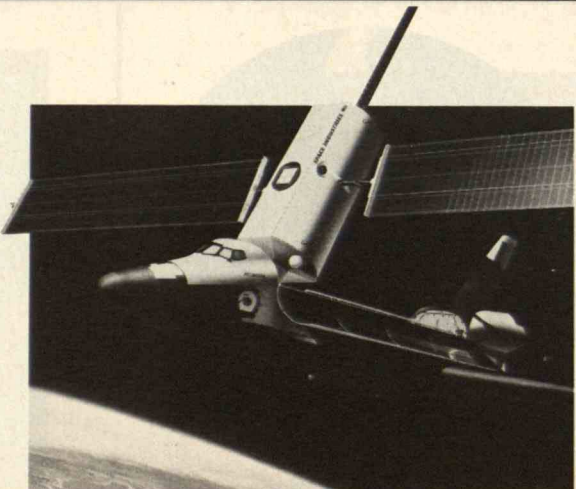
Further, the NRC has strongly advocated giving the space station adequate and predictable resources, suggesting that the program couldn't be done on the cheap.

Reflecting the careful pace of space-station development in general, the NRC panel concluded that Phase II design details were premature because the nation's long-term civilian space-program goals were still ill-defined. The panel's concerns stemmed from continued reappraisal of the goals at many government levels.

Specifically, two recent studies had produced a variety of long-range possibilities. Before the *Challenger* accident, Congress had created a National Commission on Space, and after the accident a NASA committee had proposed options for space exploration and exploitation. The suggestions from the two groups span a wide range, from automated earth-monitoring platforms to astronaut missions to Mars. Both studies propose increasingly ambitious unmanned planetary exploration and a permanent manned lunar base as intermediate goals. Each of these programs would place extensive—and unique—demands on a supporting station.

Clearly, plans for Phase II will necessarily be derived partly from what Phase I demonstrates is possible. In addition, detailing those plans requires the nation to clarify which advanced civilian space applications it wants to actively pursue early in the next century.

On December 1, 1987, NASA awarded the con-

| 1987  | 1993  | 1997  |
|---|---|---|
| <p><b>National Research Council assessment released; major development and hardware contracts awarded</b></p> | <p><b>Industrial Space Facility could be ready for use (right)</b></p>  | <p><b>NASA space station could be ready for use</b></p> |



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*The government's inconsistent policy could undermine the commitment to a civilian space-station program.*

tracts for developing and deploying space-station hardware. Boeing heads a team supporting Marshall that will concentrate on the pressurized modules. McDonnell Douglas heads a team allied with Johnson, primarily concerned with developing the station structure, control, and propulsion systems. A Rockwell-directed team will work on the station power systems with the Lewis Research Center. To develop polar and co-orbiting platforms and other satellite-related facilities, General Electric manages a team in cooperation with the Goddard Space Flight Center.

### **The Remaining Challenges**

As the nation embarks on Phase I, a number of political issues persist. A major question involves the intersection of military and international aims. While DOD does not directly participate in the space-station program, it consistently advocates keeping its option to do so, and it has carefully tracked station plans. DOD sees several potential military uses of the station, including construction and servicing of large satellites. DOD could also perform long-term test and development activities on the station, such as investigating how space affects solid rocket fuel, experimenting with switches that are based on liquid metal, and testing construction materials made out of lunar rock.

DOD's desires could have jeopardized international cooperation, blocking not only the scientific and political benefits but also financial contributions of \$5 billion or more. After Reagan invited participation from allies and negotiations began, then Secretary of Defense Caspar Weinberger said that the United States was "paying too high a price for international cooperation." He insisted that DOD keep the right to "conduct national security activities on U.S. elements of the space station, without the approval of other nations."

This position raised concerns among potential international partners, significantly delaying agreement on their involvement. Europeans expressed a fear that DOD might restrict station-related technology transfer, limiting the industrial use of innovations to those DOD deemed acceptable. Japan worried that some DOD ventures could conflict with its constitutional restrictions on military activity. And Canada wanted assurances that DOD activity wouldn't preclude fair access to all facilities.

Since Weinberger's resignation, DOD objections have abated (at least publicly). Some recent progress on international agreements has occurred, including a tentative pact with Canada and another with ESA. Both could be signed this year. Negotiations with Japan are still snagged, however. Owing to the slow pace of the talks, domestic contract work has begun before international contributions and responsibilities have been fully established.

Some legal and technical hurdles will arise when crews and facilities from different nations are blended. For example, patent protection and associated rights to products invented in space vary from country to country, as do electrical systems and dimensional standards. Criminal law standards for a misdeed in orbit, when they are established, could no doubt differ, too.

Beyond the unresolved political issues, space-station assembly and operations present a challenging mix of technical activities. In one area—how to assemble the station—considerable analysis is in progress. Particular attention is needed to find ways of attaching modules to the keel and erecting very large truss structures.

Several of the promising ideas for how to put the station together are based on a technique called experimental assembly of structures in EVA (EASE) developed at M.I.T. Based on extensive time and motion studies conducted in water tanks to simulate EVA, EASE uses specially designed, standardized joints and beams to quickly erect large structures. The procedures are easily mastered even by astronauts in cumbersome suits. This approach was tested during a 1985 shuttle flight, but even if a similar technique proves appropriate, the problem of controlling the movement of all the partly built sections will still need to be solved.

Another technical need, suggested by the Seamans' NRC panel, is to develop unmanned NASA vehicles to supplement the shuttle. With less-frequent shuttle flights and the increasing backlog since the shuttle grounding, payload space will be scarce for the next decade. DOD and non-station civilian uses of the shuttle, combined with station deployment and logistical support, could lead to a bottleneck. DOD is expanding its own fleet of expendable launch vehicles, thereby reducing the problem, but the civilian need for such craft persists.

Joint operations between unmanned spacecraft



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*Decisions made in Washington  
over the next year could govern U.S. space programs  
into the next century.*

and the station will also be introduced by orbit maneuvering and transfer vehicles. Currently, shuttle crews manually perform rendezvous and proximity operations, collision-avoidance activities, and traffic control with complex procedures. But as the number of interacting vehicles increases and new tasks limit a crew's available time, advanced automated methods will be needed to ease the astronauts' responsibility when communications links are intact and to ensure fail-safe control when links break down.

### **Congress: The Final Frontier**

Significant political and technical hurdles remain, but they are no more daunting than those that faced previous major space initiatives in less technically sophisticated and equally complex political arenas. For example, the Apollo program, approved before the United States had placed an astronaut in orbit, proceeded through the Vietnam War era.

Congress, however, has been slow to act, and recent congressional budget decisions reduced current-year appropriations to 40 percent below the administration request. This has raised the possibility of delaying the completion of the station up to a year.

Moreover, the legislation directed NASA to perform yet another design review before March 1988. Apparently, Congress hoped to find ways to further limit annual station-related budget outlays. NASA access to half of the space station's appropriated 1988 funding depends on the political actions that follow this review.

In light of the CETF and Seamans' NRC studies, little new technical input will result from this report. Nevertheless, the administration has been holding up its release. For the time being, the situation makes program planning a futile exercise.

Rather than constrain the space-station program further, Congress needs to explicitly address the instrumentation funding problem. NASA-sponsored research is expected to be one of the first major uses of the station, but instruments unique to a particular investigation must be financed separately. For example, new telescopes, earth sensors, and pressurized laboratory equipment are needed for science applications proposed by NASA and the National Oceanographic and Atmospheric Administration. Instruments could require a decade to develop, but funding has been lacking, except for some modest

allocations toward an operator-controlled, low-gravity material-processing facility in NASA's 1988 budget.

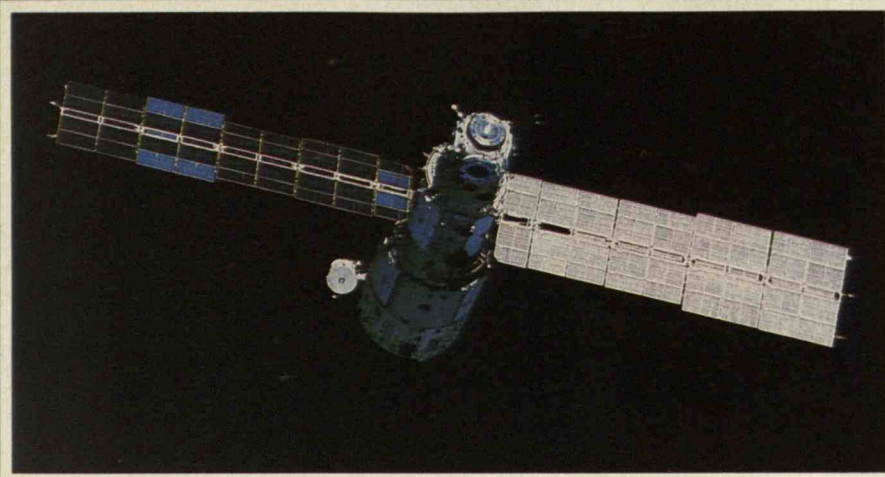
Similarly, commercially sponsored studies in material processing, satellite servicing, advanced structure erection, precise orientation control, and other areas are proposed for the station, but constantly shifting policy regarding commercial space activity has hurt such research. To encourage potential investors, the costs and rules for using the station will have to remain stable for an extended period.

The case of a proposed complementary commercial facility illustrates how the government's inconsistent policy is complicating long-term space-station planning and possibly undermining the commitment to a civilian space-station program. Earlier this fiscal year, Congress provided NASA with unrequested funds to explore leasing arrangements with Houston-based Space Industries, Inc., the firm developing the privately funded Industrial Space Facility (ISF). While commercial clients for the ISF had been slow to commit, the Department of Commerce and some members of Congress had been pressuring NASA to sign a lease for 70 percent use of the facility. The congressional funds were accompanied by a legislative clause directing NASA to conclude an agreement that would lead to leasing a workable ISF by 1991 or 1992.

Requiring periodic shuttle flights for deployment and astronaut servicing, ISF could support automated experiments primarily oriented toward low-gravity material-processing studies. Generally unattended, ISF would depend on shuttle-based astronauts for maintenance, restocking, update of the experiments, and removal of products. The project's promoters claim it could be launched in 1991, although shuttle launch commitments are likely to prevent deployment until 1992 or 1993. This schedule appeals to researchers since it is earlier than any date the space station would be operational.

Recently, the administration appears to have shifted its policy, leaning toward the position that has been advocated by the Commerce Department and some congressional leaders. Embodied in a presidential statement released February 11, 1988, the new policy reaffirms support for a permanently manned public-sector space station, but at the same time provides for future backing of a major private-sector space program that would also include a space





**Mir, the third generation of operational Soviet space stations, is part of a steadily funded, incrementally upgraded program. Activity began shortly after Mir's launch, providing a degree of permanence to the cosmonaut presence in space. Deployed piece by piece, the station is expected to grow substantially as the Soviets add laboratory and living facilities to its multi-port attachment node.**

**Mir is now supplied by two classes of expendable launch vehicles, but a Soviet space shuttle may take over in the future. The first launch of the new shuttle is expected to piggyback on the new *Energia* super-boosters later this year. The *Energia* could also launch very large components to construct more advanced space stations.**



station. In a press conference unveiling the new approach, Commerce Secretary William Verity declared that it "shifts the major responsibility for space development from the public to the private sector." NASA administrator Fletcher later said that the agency "will take the lead in getting a commercially developed space facility off the ground. . . . We expect to be awarding a contract by the end of July" to build a craft that matches the ISF's advertised capabilities. The agency would then probably arrange a five-year, \$700 million lease on space in the private facility.

Some political leaders see ISF as a low-cost private alternative to the NASA station. However, even ISF's developers correctly perceive it as complementary. Unlike the station, the ISF wouldn't have a life-support system. Nor could ISF, designed for commercial

applications, fulfill the life-science, servicing, and construction roles envisioned for the NASA space station.

As Maxime Faget, president of Space Industries and former top NASA engineer, writes, ISF is not an alternative to NASA's plans—"Nothing could be further from the truth." He describes ISF as a test facility where "operational experience gained . . . would be useful as a precursor to [the] space station . . . and can serve as a catalyst for the development of equipment and uses of the space station." He asserts that "in the next century the very viability of Space Industries . . . will be possible only if there is a permanent space station."

Apparently Congress has now become suspicious of the administration's new commercial space policy and has reconsidered its support of an ISF-class plat-





**Workers install equipment in Boeing Aerospace's full-scale mock-up of the space station's living and working quarter.**

form. In mid-March, Rep. Edward Boland (D-Mass.) wrote Rep. Bill Nelson (D-Fla.) that it was inappropriate to apply funds to the new administration policy without congressional authority, thereby causing NASA to suspend plans to request competitive industry proposals. Also, potential ISF competitors fear quick government action puts them at a disadvantage. Negotiations between NASA and Congress continue, with an uncertain budget impact on the space station and commercial facilities. Some in Congress have now suggested a need to choose among proposed orbital platforms before acting on any future funding.

Decisions made in Washington over the next year will be the key to U.S. space programs into the next

century. Comprehensive reviews have provided more than sufficient information to establish policy. If Congress provides funding requirements on the requisite schedule—and if shuttle operations resume in 1988 as currently planned—the first components of a U.S. space station could be orbited in 1994 or 1995. Phase I would be completed about three years later. Provided that the public and its political leadership support some or all of the civilian space goals derived from 25 years of careful evaluation, the United States will have a necessary first element of a permanent orbital infrastructure. The space station's design and the objectives for its early stages are now evolved enough to proceed promptly and confidently toward development. □



GEORGE SHULTZ  
KEYNOTES  
WASHINGTON  
CAMPAIGN  
KICK-OFF





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GEORGE SHULTZ  
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## COVER

Secretary of State, George P. Shultz, Ph.D.'48, tells his Washington alumni audience that trade barriers can lead only to economic stagnation (see page 15).

(Photo by Rick Reinhard)

# From Rural Maine and Urban Cambridge



## A BETTER "DOWN EAST" STORY

The *Review* (April, p. MIT 17) is in error reporting that artist Charles Woodbury and his wife "traded some of his paintings for a parcel of land in Ogunquit" at the close of the 19th century. But the story has a grain of truth, and therein lies a humorous tale.

When Woodbury sought to buy an eight-acre parcel on the rugged Maine coast from farmer Jeddiah Moses Perkins, the owner's first response was, "What you want that land fur? You ain't got no cows to pasture on it." Several years later, safely installed in his studio on the land, Woodbury painted a picture of one of Jeddiah's cows grazing nearby and sold it for the price of the land. Needless to say, Jeddiah was flabbergasted.

INDIA WOODBURY  
Ogunquit, Maine

The writer is Charles Woodbury's daughter-in-law, the wife of the late David O. Woodbury, '21.

## NO "THRUST," NO "PRONG"

We recently won the Boston Society of Architects' student competition for our design of a transition shelter for homeless and battered women (see February/March, p. MIT 34). But our involvement in this competition was not in any way part of a fictitious new "thrust" coming out of M.I.T. Though Professors Sandra Howell and Jorge Andrade gave us excellent critiques as our advisors, this project was not part of any design studio curriculum, and none of the M.I.T. students was awarded academic credit for the work (although students at two other local architectural schools did receive credit for their entries).

For a prestigious institution like M.I.T., with its massively subsidized research projects in engineering and science, to

label this little competition as the "prong" of a "thrust" is not just ludicrous; it is downright deceitful. Let no alumni be confused into thinking that there is a major new effort under way at the Institute to deal with the timely and critical issues of housing design for homeless or low-income clients in our American context. It is just not true—though it should be. Our effort cannot be used as a foil to counterbalance the harsh criticism the administration has received for its handling of the "Tent City" controversy on the Simplex development site.

NEAL MONGOLD, DANIEL GLENN,  
LAURA SPARK, and PABLO LUNA  
Cambridge, Mass.

The writers are graduate students in the Department of Architecture. The two other activities referred to in the article they cite were a \$250,000 project in the Department of Urban Studies and Planning to commission and publish studies on the federal role in housing for low- and moderate-income people in the Center for Real Estate Development.

**HURTING BLACKS, NOT APARTHEID**  
Stephanie Pollack's comments on M.I.T.'s sound decision to retain its stock in companies doing business in South Africa ("Dangerous to Divest," April, p. MIT 2) fails to note a critically important fact. Pollack seems unaware that in general the companies leaving South Africa do not bring their businesses home with them; they sell them to South Africans. Such transfers are unlikely to affect apartheid policy; they are more likely to hurt black employees of the enterprise than the South African establishment.

GORDON LISTER, '30  
Green Valley, Ariz.

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## Tech Coop: Your Source for the Latest in Lingerie Fashions!

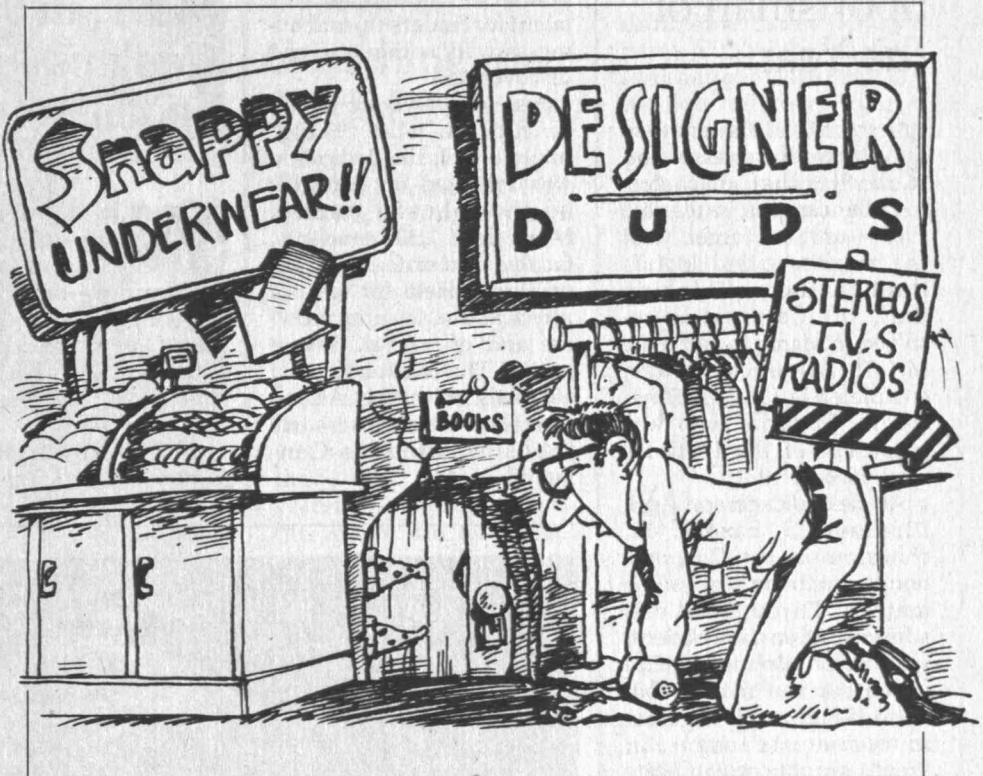
The Harvard Cooperative Society has served Harvard and M.I.T. since 1882, and each Coop location is designed to meet the special needs of its individual academic community. Harvard Square's tweedy corner boasts an entire building of books, where patrons can savor the works of a favored Romantic poet or peruse New England's finest collection of art posters. Here at M.I.T., the Coop brings us The New Boutique at Kendall Square, perfectly provisioned to indulge that world-famous M.I.T. demand for Catalina swimsuits, Christian Dior socks, made-to-measure suits, silk ties, and other upscale clothing. Returning to Cambridge after a year's sabbatical, I found the Tech Coop transported across the campus and refashioned in the image of Bloomingdale's. Only upon my second visit did I realize that the Coop still sells books at all and discover a route to the well-concealed texts.

Entering from Main Street via the western door, you stroll past the Chaus sweaters and the Jessica Howard dresses and approach the Maidenform black, string-bikini panties ("Sweet Nothings"). Turn left and squeeze through the gap between the panties and the abbreviated "Hidden Fantasies" silk camisoles. Left again, down the unmarked escalator, about face at the pile of fake Persian rugs, and through the turnstile brings you at last to the Coop's book section.

What an eye-opening journey! I was raised with two sisters and have shared laundry with the woman I love for almost 20 years. All the furniture in our house is draped with our teen-age daughter's washables. Yet in one month of buying books at the Coop, I have come into more close contact with fancy lingerie than ever before in my life.

I suspect that the new Coop's layout is part of some well-crafted scheme for remaking M.I.T., and that the first-draft plans for the relocated Coop were nothing like this. Those worthy merchants surely intended to bring us a repeat of the ground floor of the Student Center, with

*HAROLD ABELSON, Ph.D. '73, is associate professor of computer science and engineering at M.I.T.*



prominent displays of calculators and CRC tables—and perhaps a collection of those plastic pocket liners you use to keep your pens from running all over your shirt front. But somewhere along the line, an alert public relations expert must have slithered out from beneath the Great Dome and strangled those innocent plans.

No, the old Coop, shamelessly flaunting its engineering texts, was projecting a totally unsuitable image. Today's M.I.T. must style itself as a well-rounded university peopled by well-adjusted students. Even Coop window displays of tapes and compact discs might suggest suspiciously nerdy undercurrents. Much more prudent to bury all trappings of technology and accentuate fashionable clothing.

Besides—more effectively than any number of context subjects and expanded humanities units—forcing Jane and Joe Tool to rub their noses in sexy underwear on the way to buying the 6.014 text might,

just might, distract them from their narrow-minded obsession with solving yet another differential equation.

M.I.T. identity crisis or not, I suppose the Coop's gentrification was inevitable. In Palo Alto, the Stanford Mall houses the trendiest suite of shops on the entire San Francisco peninsula, and Princeton University is about to excrete New Jersey's premiere upscale emporium onto the Forrestal campus. Even Berkeley's Telegraph Ave. has become Evening Magazinized, the street vendors hawking earrings and tie-dyed shirts rather than mescaline and LSD.

But they are Stanford, Princeton, and Berkeley; and we—we're the INSTITUTE! I'm entranced by visions of engineering freshmen, eager to get a headstart on their subjects during R/O Week, scouring the Coop for fall-semester texts as they waltz past mounds of Persian rugs and swim through waves of negligees. □





## UNDER THE DOMES

### Sportsman of the Year

In the 1980s, it's very easy to forget the stresses and conflict that characterized the campus in the late 1960s—and to forget, too, the man who led M.I.T. through them. Thinking thus, the Corporation resolved in March to name the M.I.T. Athletics Center, completed in 1981, for Howard W. Johnson, who was president of the Institute from 1966 to 1971.

At the dedication on April 22, David S. Saxon, '41, chairman of the Corporation, went to the heart of the matter: Throughout his administration as president, said Saxon, Johnson demonstrated "remarkable ability to bring people together in common cause. . . . Words cannot communicate the significance of his leadership in the late 1960s." Saxon also noted Johnson's role in the Leadership Campaign that raised funds for the Athletic Center and later his success in "bringing many user groups into harmony" during its design.

Johnson responded with delight, identifying the building named in his honor with M.I.T.'s lifelong commitment to its students' full

potential—"developing the talent for leadership and living as well as thinking and discovering."

Just so everybody would be clear on what "living" might entail, the dedication was followed on Saturday by the Johnson Games. More than 1,300 students, faculty, and staff assembled on Briggs Field for tests of physical and mental prowess and of wit and imagination. The weekend ended elegantly with the Athlon Ball in—of course—the Johnson Athletics Center. □

### M.I.T. in the Congressional Spotlight

Was it intentional misreading of the data or an honest—and minor—error that is part of progress at the frontier of any complex science? Or was the science in fact correct, as the researchers still maintain?

In the spotlight of a congressional hearing room

in April, a witness charged fraud in the handling of data behind a major genetic development reported from M.I.T. in *Cell* magazine in 1986. But most observers seemed confident that the problem is at most well-intentioned and modest misinterpretation of data, exacerbated by some personality conflicts at M.I.T. and by some zealous whistle-blowers at the National Institutes of Health, which sponsored the research.

Two weeks after the congressional hearings, Daniel E. Koshland, Jr., editorialized in *Science* magazine, "Science cannot tolerate fraud, but it should not be at the mercy of headline-happy journalists or incompetent whistle-blowers."

The paper in *Cell* reported experiments from which six authors led by then Assistant Professor Thereza Imanishi-Kari at M.I.T. (and including Nobel laureate Professor David Baltimore, '61, director of the Whitehead Institute) reported an important new conclusion: genes native to a host cell's DNA seem to copy the function of genes artificially transferred to the host.

The trouble began when an M.I.T. postdoctoral fellow working in the laboratory of Imanishi-Kari challenged conclusions she read in the paper when it was about to go to *Cell*. Told her complaint was of marginal impact, postdoc Margot O'Toole declined to make a formal complaint: the cards seemed stacked against her, she said. Later, she "left science saddened



*After dedicating the Athletics Center in his honor, M.I.T. celebrated its affection for Howard W. Johnson, 12th president, with a day of community sports events over which Johnson and the Institute's beaver mascot presided.*





*Students and members of the Cambridge community who believe that development of M.I.T.-owned property in Cambridge should include provision for the homeless staged a demonstration during the*

*spring Corporation meeting. Corporation member Joe F. Moore, '52, (back to camera) listened to what they had to say, because as a trustee he needs to understand any "significant dis-sension" on the campus.*

and disillusioned" and is now unemployed, she told Representative John Dingell's oversight and investigations subcommittee of the House Energy and Commerce Committee.

Witness Charles Maples, '72, formerly a graduate student in Imanishi-Kari's laboratory and now working at T Cell Sciences, Cambridge, went one step further. He charged Imanishi-Kari, who is now on the faculty of the Tufts School of Medicine in Boston, with fraud.

None of the authors of the contested paper was invited to the hearings. From Cambridge, Baltimore issued a statement pointing out that

the material in contention is a "small portion of the data that led to the conclusions reached in the paper. . . . The problem is merely one of interpretation," he said, and subsequent research by others has resulted in no serious contradictions.

At the time of the hearings, the dispute was already being investigated by the official "misconduct" office of the National Institutes of Health as well as by the two self-appointed fraud researchers at NIH who appeared as witnesses. If Dingell's hearings accelerate the official investigation, the interests of both Baltimore and Imanishi-Kari will have been well served. □

## Forrester Searching for High Leverage

Jay W. Forrester, S.M.'45, M.I.T.'s Germeshausen Professor, has spent most of his career looking for the high-leverage points that can really change the way things work.

To find them, said Forrester, you have to understand the dynamics of the systems you want to change. And that's hard. All dynamic systems—natural, technical, and social alike—are governed by feedback, and our mental models too often fail to include this basic aspect of dynamic behavior.

Forrester made these points in his lectures this spring as winner of the 1988 James R. Killian Jr. Faculty Achievement Award.

Consider, he said, the plight of People Express airline. The simple relationship of low fares and high volume masked for the management what Forrester considers the dynamic consequences of growth—especially the needs for more staff and the time and money to train them.

Given the assumptions of the People Express management, computers using dynamic models replicate precisely the problems that People Express experienced, the solutions that management attempted, and—soon enough—the demise of the company.

The computers also display some high-leverage policies—notably early investments in hiring and

training programs—that could have saved the company. Put in the technical language of system dynamics, an emerging academic field that recognizes Forrester as its founder, such high-leverage policies "are those not embedded in feedback loops strong enough to defeat them." □

## Big Jump in Minorities

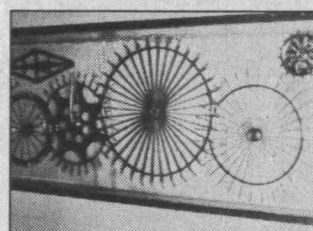
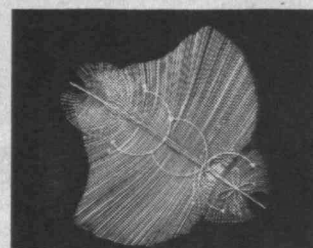
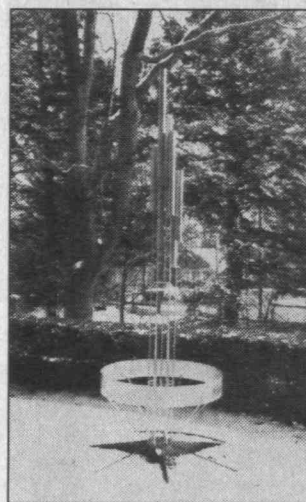
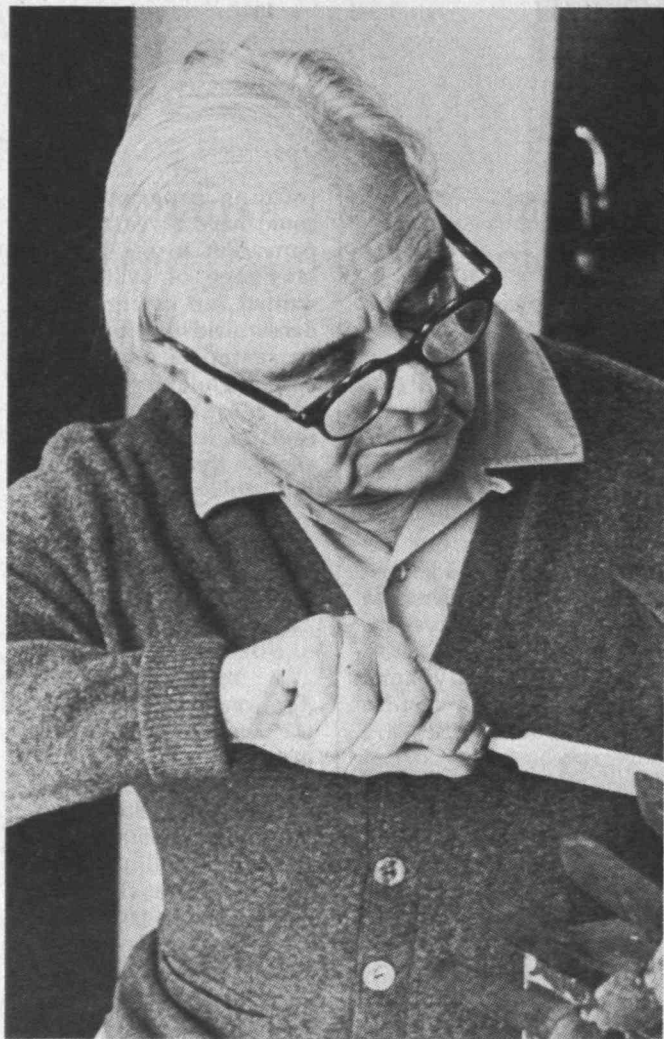
A record number of minority students—up nearly 20 percent over 1987 and nearly double the number as recently as September 1985—are expected to enroll in the Class of 1992 this fall.

Projecting a class of no more than 1,000, the Admissions Office admitted 1,794 applicants. Of them, 289 (16 percent) were members of underrepresented minority groups—Blacks, Puerto Ricans, Mexican Americans, and Native Americans—and 621 (35 percent) were women.

A record number of the applications came from overseas, Behnke said, but the number admitted reflected the general agreement at M.I.T. that only 6 to 8 percent of an undergraduate class should be foreign students.

The increase in minority students is the pay-off from an intensified recruiting effort in the Admissions Office and new policies for financial aid: new publications, more travel by a larger admissions staff, and new grants for economically dis-





M.I.T.'s 1988 Kepes Prize, for a member of the Institute community who demonstrates "a concern for human values as reflected in the relationship between art and the environment," has gone to Professor Emeritus C. Fayette Taylor, '29, of the Department of Mechanical Engineering.

Taylor's sculptures represent "the passion of the engineer, the precision of the artist," said Angus MacDonald, '46, who presented the award at the annual meeting of the Council on the Arts at M.I.T. It's named in honor of Institute Professor Emeritus Gyorgy Kepes.

advantaged students.

Not only was the number of minority applicants for the Class of 1992 increased; the admission rates for minorities and women were significantly higher than for the class as a whole, according to Michael C. Behnke, director of admissions. While M.I.T. accepted only 24 percent of all completed applications, 37 percent of the women and 53 percent of minority applicants gained admission.

Two reasons:

□ Women and minority applicants appear to be highly "self-selected," Behnke ex-

plained to Gaurav Rewari, '91, of *The Tech*. Minorities and women receive less encouragement in science than other high school students, and only those who are strongly motivated apply to schools such as M.I.T.

□ Because it wants to increase the presence of minorities on the campus as well as the role of minorities in the professions, M.I.T. tries to admit all the academically qualified minorities who apply, said Behnke. They are "removed to some extent from the competition" with other students, he told Rewari. □

## Ethics at Work

Ethics in the Workplace was the focus of the 8th annual Career-Development Conference for Women in Technical Careers held at M.I.T. in April. Sponsored by the Association of M.I.T. Alumnae (AMITA) and the Society of Women Engineers (SWE), it drew more than 200 women and a sprinkling of men to a day of talks, panel discussions, and workshops.

The keynote speaker was Caroline Whitbeck, Ph.D. '70, senior research

scholar at the Center for Technology and Policy at M.I.T. and senior lecturer in the Department of Mechanical Engineering. She spoke on the new standards of professional ethics for engineers and the demands that a changing work environment now place on employees.

Whitbeck maintains that technological developments do not so much create more problems as they raise ethical considerations outside the realm of our traditional moral framework. Engineers, trained in problem solving and risk assessment



and reduction, are frequently the shock troops in the battle of the bottom line. Since they are involved in the genesis of new technology, they are often the first to detect a potential problem. Then the question becomes: "How strong a suspicion of risk do I need in order to engage in further expensive testing to quantify the risk?"

Women engineers, who often feel that their mere presence in engineering jobs violates the expectations of their male colleagues, may be more willing to further violate those expectations by being the first to sound an alarm when they recognize a risk. If you are already a maverick, Whitbeck suggested, you may have less to lose.

Whitbeck outlined some effective methods and procedures that individual engineers can employ to notify and convince management of questionable situations. She also addressed what engineering societies can do to encourage the development of permanent mechanisms within corporations to resolve problems before they reach the whistle-blowing stage. She stressed that professional organizations must do more studies and must vigorously advocate changes in ethical structures and methods of communicating concerns.

During the panel discussion that followed, panelists and members of the audience raised a number of issues: the perils of accepting personal responsibility for corporate behavior, and gender differences in ethical responses. Of this last, one

woman spoke of the distinction between errors of omission and of commission. Another observed that women tend to see power as responsibility, while men equate it more with authority. "If you put together how men operate and women operate, you get a whole person," remarked panelist Judy Perrolle, associate professor of sociology at Northeastern University. □

## Making Headway in Student Government

**H**is year as president of the Undergraduate Association (UA) was a success, said Manuel Rodriguez, '89, who stepped down from the post late in the spring. But there are many issues remaining on the UA agenda.

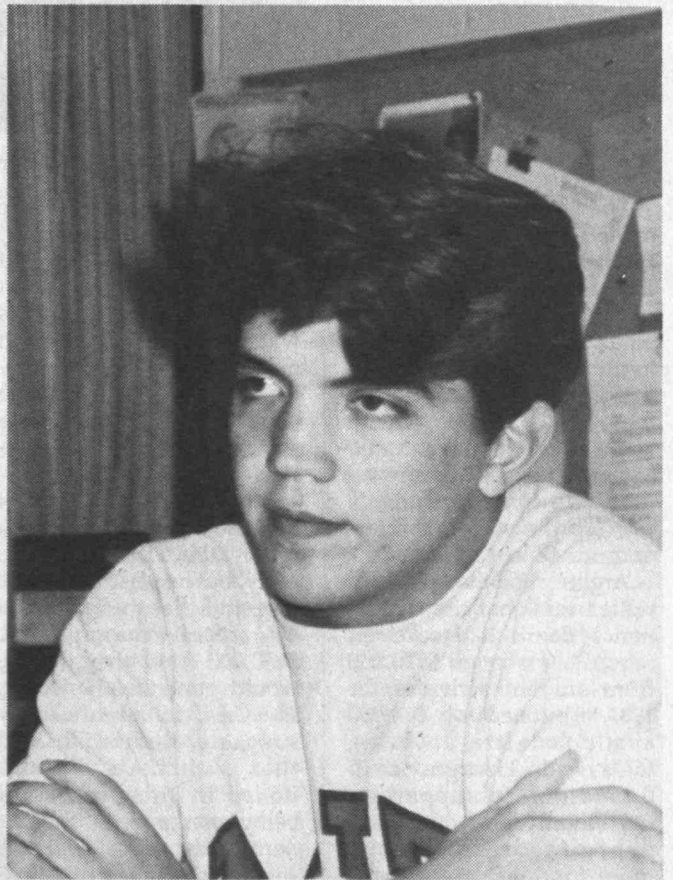
UA's biggest success was its strong role in the movement for curriculum change at M.I.T., he says. He was also instrumental in avoiding an increase in the self help level for students on financial aid. But there were too few campus-wide social

events, a fact he attributes to funding problems and the student officers' preoccupation with educational policy. And a student referendum rejected his administration's solution to those funding problems.

A major achievement was the UA student committee's study of the undergraduate humanities, arts, and social sciences distribution requirement. "It felt really good to see faculty stand up with our report in hand and say that students are really doing something about this

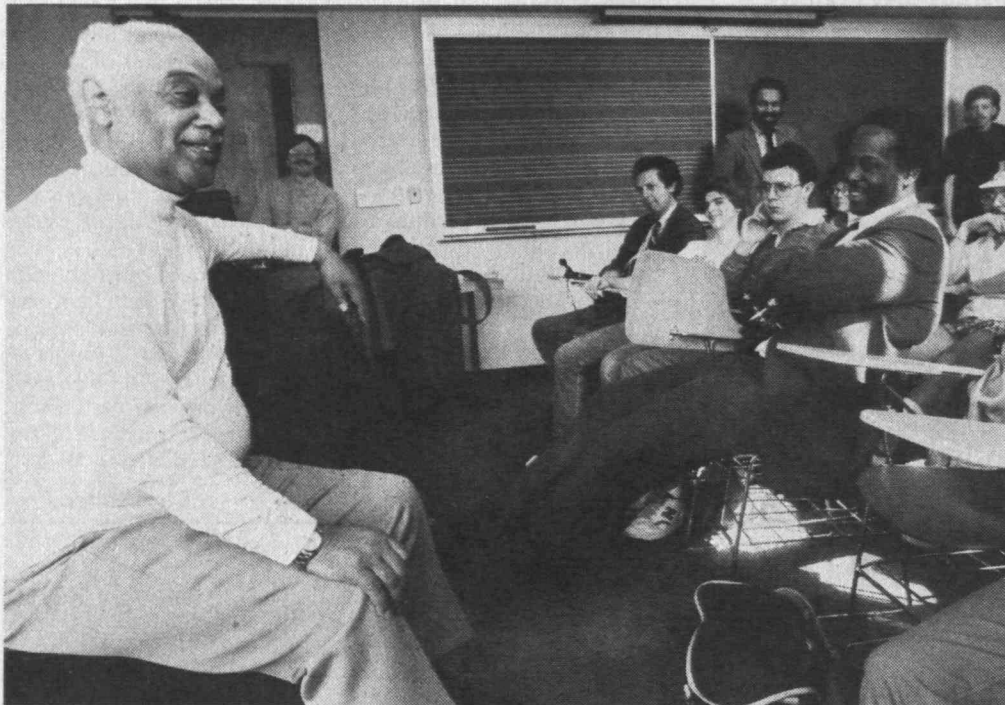
issue," Rodriguez told Darrel Tarasewicz, '89, of *The Tech*. As a result of the student report, the plans for revising HASS-D requirements were modified to allow a wider range of subjects than originally proposed by a faculty committee.

Rodriguez' partner, vice-president Alan B. Davidson, '89, predicted the same result for the UA's report on the first year. "It will be different from the one that the administration drafts," Davidson predicted.



*It was a year of major contributions to curriculum change at M.I.T. by the Undergraduate Association led by Manuel Rodriguez, '89. But frustrations, too: his plans for a fee to assure funding for student activities failed in a student referendum.*





*How and why has the Ellington Orchestra changed since the death of its founding genius Duke Ellington? Students in lecturer Mark S. Harvey's class in the history of American jazz know the answer first-hand—in the words of Ellington's son Mercer, director of today's Ellington Orchestra. Mercer gave two lectures to M.I.T. music students early in the spring, just two days after receiving a coveted 1988 Grammy for the year's best jazz big band recording.*

The UA did mount a major effort to address the problem of funding for student activities. Trapped between rising costs and an almost constant budget allocation from the Office of the Dean for Student Affairs, the UA proposed late last winter to add an annual \$18 activities fee to every tuition bill. But the students rejected the plan in a referendum, 47 to 42 percent.

Arguing for the fee, Rodriguez said that the UA Finance Board had received requests for over \$210,000 from student activities for 1987-88 but had only \$44,000 available after covering UA's needs. He argued that, in addition to supporting the initiatives of other student-run organizations, more funding would make

possible more campus-wide social events—important, he said, because “the gulf between dormitories and independent living groups is widening.” Activities need more money, too, Rodriguez urged, to meet the needs of “the more diverse group of students” being attracted to the Institute.

The plan was scuttled not because students were put off by the \$18 fee, apparently, but because they were skeptical that the UA could effectively manage the \$150,000 fund that the fee would generate. However, *The Tech*, in an unusually supportive editorial, said that with UA's Finance Board in the process of being reorganized, “the student body would be well served by a student activi-

ties fee.” Rodriguez says he will try to win support for the fee again next year. □

## GEM Fellows

Thirteen M.I.T. undergraduates will go to graduate school next fall under GEM fellowships—grants from the National Consortium for Graduate Degrees for Minorities in Engineering. Each will receive tuition, fees, and a \$5,000 stipend to attend any of 55 major universities that are program participants.

Nationwide, there will be 156 new GEM fellows in 1988-89, and M.I.T.'s 13 is the largest number from any school in the nation. □

## More Profit in Invention?

In their efforts to license campus inventions overseas, U.S. universities need “a level playing field”—no discrimination, no special benefits. But in fact they're at a big disadvantage and need federal help, says Edward O. Vetter, '42, former under secretary of commerce, now a consultant in Dallas, Tex.

Licensing of campus inventions brought \$30 million to U.S. universities in 1987, Vetter told the Alumni Association's Boston Seminar in April. But little if any of that came from overseas, because foreign licensing is “a complex, expensive procedure that most universities cannot undertake,” Vetter said. The national interest would be well served, he said, by federal expertise and funds that helped universities in their quests for overseas licenses. □





## ALUM. NEWS

### A Chair for Crew

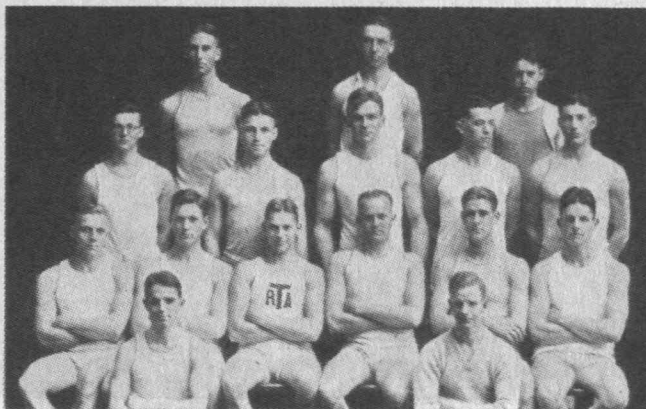
The nation's first coaching chair for crew has been established at M.I.T. by a gift from Horace W. McCurdy, '22, life member emeritus of the Corporation who was captain of M.I.T.'s first varsity crew team more than 65 years ago.

McCurdy's first contribution to crew at M.I.T. occurred when he arrived in 1919 and found an inchoate and ill-equipped sport that needed his leadership if he was to enjoy the rowing he'd begun at the University of Washington before serving in World War I. The team achieved varsity status his senior year and elected him captain. In the ensuing years he has funded a series of shells, the McCurdy Lounge in the Pierce Boat-house, and the H.W. McCurdy Endowment for Crew, and he has lent his support in numerous other ways. He is a member of the National Rowing Hall of Fame.

A native of Washington State, McCurdy returned to Seattle after graduating from M.I.T. in mechanical engineering where he was elected a charter member of Tau Beta Pi, the first honorary society at the Institute based on scholarship. Beginning as a laborer and timekeeper, he rose through the ranks at the Puget Sound Bridge and Dredging Co. to chairman of the board in 1959, then sold the company to Lockheed and served as board chairman of



1921 Crew



*Captain-elect Horace W. McCurdy, '22, with teammates on the 1921 Crew (seated third from the right in the bench row).*

*Borrowed shells and oars were a standard handicap for M.I.T. then; thanks in good measure to H.W., all that has changed.*

the Lockheed Shipbuilding and Construction Co., as his former company was now known.

McCurdy was also a board member of the Lockheed Aircraft Corp., and upon retirement from Lockheed in 1970, he was elected chairman of a family-owned business, the Puget Sound Dredging Co. He continues in that capacity today.

In addition to extensive involvement in numerous civic activities, McCurdy has found time to write (with Gordon Newell) an autobiography entitled *Don't Leave Any Holidays*, and is

the co-author of *The Marine History of the Pacific Northwest* and a biography of shell-builder George Pocock, among other books.

In expressing his appreciation for McCurdy's latest gift, President Paul E. Gray, '54, noted that it is "one more example of the extraordinary leadership and great generosity Mac has demonstrated in regard to M.I.T. for almost 70 years. We are deeply in his debt." McCurdy's enduring support for rowing at the Institute has earned him the official designation of "Father of M.I.T. Crew." □

### Growing Fast

Two of the three fastest-growing companies in Massachusetts according to *Inc.* magazine's "500" list for 1987 are headed by M.I.T. alumni. They are Steven G. Finn's Bytex, Inc., and David B. Spencer's WTE Corp.

To make *Inc.*'s "500" list, a company must have achieved a 526 percent increase in sales in the last five years, have annual revenues between \$100,000 and \$25 million and fifth-year sales that exceed the previous year's, and be independent and privately held.

Bytex qualifies handsomely: its sales of specialized electronic switches for the data communications industry have gone from \$646,000 to \$25 million between 1982 and 1986—up 3,763 percent. Finn, whose M.I.T. degrees (S.B. '68, Sc.D. '75) are in electrical engineering, credits the performance to hard work and "a good market niche."

WTE Corp. was a spinoff from Raytheon Co.'s waste-to-energy activities; after several years with Raytheon, Spencer and his partner decided they could do it better. Sales have gone from \$207,000 to \$7.7 million in the 1982-86 period. But Spencer, whose M.I.T. Ph.D. is in materials science and engineering (1971), admits "I never envisioned it would be so hard. . . . Sometimes we wonder if the personal price is worth it," he told the *Boston Globe's* Mary Sit. "It's very hard on your family." □



## M.I.T. Rugby Makes a Good French Impression



*Muddy but uncowed,  
the rugby club gave  
France a fine exhibi-  
tion of American  
esprit de corps.*

**N**early three dozen rugby players from M.I.T. charmed their way through Paris and Reims, France, during March break. In their wake they left a new view of what M.I.T. is about, a large assortment of jerseys and Institute memorabilia, and enthusiastic invitations to come again.

The group, composed of grads and undergrads of both sexes, including minorities and foreign students, was continuing a biennial European tour tradition. The previous trips, however, had always been to England, even though France shares with the four countries of the British Isles the distinction of being the top rugby-playing nations in Europe.

Former club president Joe Goss, Ph.D. '86, who had recently moved to France to work for Schlumberger, established the French connection with grad student Leo Casey, a native New Zealander and member of the M.I.T. club for seven years. With Casey and others organizing on the American end, Goss got the ball rolling on the Continent and arranged for a Parisian club, the *Stade Français*, to serve as hosts.

The French club ensured that the visitors' first impressions would be good ones by throwing a champagne and cavaliar party on the night they arrived.

The first game, against *École Polytechnique* the next day, drew a number of alumni who had been alerted by the M.I.T. Club of Paris. They proved to be an enthusiastic and loyal cheering squad, with some showing up for the final game a week later as well.

If the crowd was all that could have been hoped for, the field was not: it had been a cow pasture in the not too distant past, and what looked like topsoil was in fact deposits from its previous tenants. Covered with smelly mud, the team had to try to get clean with only cold showers available afterward, and their gear was accidentally locked up wet and unwashed for two days. It was a test of the toughness for which ruggers are famous.

### Rugby and Champagne

After a second game in Paris, this one against *École Centrale*, the Americans headed to the city of Reims, best known for its 13th-century cathedral and its 20th-century champagne. Here again

they were warmly welcomed: for many of the older inhabitants this was the largest group of young Americans they had seen since World War II. They seemed pleased that this time the influx was for sport and not deliverance.

The "Old Black Label" team in Reims included a handful of middle-aged, cigar-puffing champagne distributors with ample girths and handlebar moustaches. Easily winded, these fellows only played for a few minutes at a stretch—but they gave it their all while on the field and put up a formidable front. M.I.T. still won the match.

Blending culture with sport, the team toured the local champagne caves, 14 miles of underground wine cellars in ancient Roman chalk pits. Their French guide mentioned that her favorite song was the "Star Spangled Banner" and that she watched the Olympics just to hear it. The team obliged, in true rugby fashion, by singing a deep, stirring rendition in the cavernous stairwell. No one even noticed if it was slightly off-key.

The final match was back in Paris against the *Stade Français*, a large elite network of athletic clubs. Although earlier the Institute had lost its closely con-

*Continued on page MIT 12*



# Wrestling With Cultural Diversity



*The Toyo University wrestlers welcomed their fellow athletes with a sartorial swap of hats and T-shirts.*



**T**o most of us, Japan evokes two conflicting images—a modern, innovative economic competitor whose culture rests in an ancient and very foreign heritage. So it was particularly intriguing for a group of M.I.T. wrestlers to immerse themselves in Japanese culture for the spring break. They found, of course, that what seems a conflict is in fact a source of strength: the Japanese are just as multi-dimensional as we are, to say nothing of being very committed athletes.

Five members of the M.I.T. wrestling team, three coaches, and Director of Sports Information Roger Crosley joined the Boston Police Athletic League wrestlers on a goodwill trip to Japan last March. Along with representatives from Harvard, Williams, the Boston campus of the University of Massachusetts, Boston Latin School, Mayor Ray Flynn's office, and the Boston Redevelopment Authority (BRA), they spent six days at Toyo University in Tokyo and four days at Doshisha University in Kyoto.

The trip was partially underwritten by Northwest Orient Airlines and All Nippon Air as part of an ongoing cultural

exchange; last year a group of Japanese sumo wrestlers made an exhibition tour of Boston.

Since the Japanese hosts, both students and coaches, had next to no knowledge of English, and the Boston contingent had to rely on a single translator from the BRA, communication at the beginning of the trip was marginal and very frustrating. "The best way for us to prepare for this trip would have been to play charades for a week," was the comment from one American.

Common interests, however, began quickly to prevail. The Japanese all bought Japanese-English dictionaries, which were dog-eared in no time. The universal desire of college students to have fun helped cut through the language barrier. "Beeru" was one of the first words assimilated by the Americans.

Before the final night in Tokyo, the Boston students had nicknamed most of the Toyo wrestlers, a practice the Japanese loved. The Japanese took pride in the names ("T-Bone," "Godzilla," and the like) and even began to refer to each other by the sobriquets, Crosley said.

The Toyo training regimen is distinctive. Each morning the team rises at 7:00

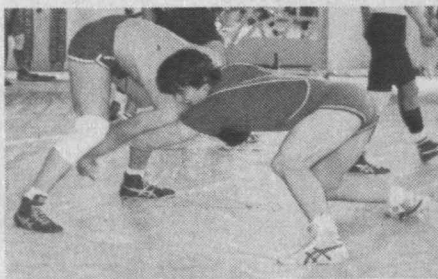
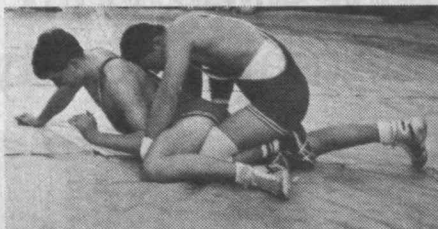
and goes for a workout, with the exception of the three people left behind to cook breakfast. Following a distance run of 5 to 10 miles, the team stops at a track or park and does various conditioning drills—sprints, stretching, and strength exercises. A light jog or walk back to the dorm preceeds more stretching and breakfast.

American and Japanese afternoon practices are quite similar. But for the same drills that Americans pack into an intense one and a half to two hours, the Japanese allow themselves a more leisurely three and half hours.

The Japanese character is most evident at the end of each practice, noted Crosley, when the wrestlers observe a moment of silence to show respect for their coach, hear remarks from the general manager of the team, and finally bow to a wrestling shrine high on the wall of the practice room.

A ritual that the Americans found fascinating was the caste system featuring freshman wrestlers. As the lowest level of the wrestling social structure, the freshmen perform all housekeeping and maintenance chores in the dorm, are required to rise early to wake upperclassmen for the morning run, and must





scrub the backs of the upperclassmen (and any visitors who may have worked out) in the shower after a practice or match.

### Taking Pride in Adversity

At some Japanese universities, wrestlers and other athletes are recruited for their sports skills and get an education on the side. Other institutions support athletics as a way to round out the students' education—not unlike M.I.T.

The Japanese concern with saving face has a strong influence on their attitude about winning and losing, and Japanese coaches have been known to make American coaches look tame in their reaction to defeat.

Although the Japanese athletes eat well and work hard to stay fit, surprisingly enough many are heavy smokers, and smoking seems to be an acceptable habit.

The Toyo University team opts to wrestle without the headgear meant to protect their ears. The result of not wearing headgear is "cauliflower ear," a nasty-looking swelling of the outer ear. Most U.S. wrestlers have doctors drain such injuries, which allows them to

*(Upper left) Taking a turn at the stove is a normal part of a Japanese wrestler's regimen; (center) exhibition matches provide a chance to observe technique. (Bottom) the rugby scrum looks like a self-conflicted centipede, but actually determines which side gets possession of the ball—until it is intercepted (right).*

heal. The Japanese, on the other hand, see the ears as a status symbol, a "red badge of courage." A cauliflower ear says "I am a wrestler and I am proud of it." There was not one upperclassman who wrestled at Toyo who did not have at least one permanently deformed ear, many had both ears damaged.

Planning has already begun for a group of Japanese wrestlers to visit the Boston area in January 1989. There is also talk of a return trip to Japan by another group of Boston wrestlers in two years. Crosley speculated that if the success of this initial wrestling effort is any indication of what is in store for these two countries, a feeling of sharing, understanding, and friendly competition should last well into the next century. □

RUGBY continued from page MIT 10

tested games against the two *écoles*, it now was able to kick in a winner.

M.I.T.'s B-Side (second string) team played two games that included the six women on the trip. During their earlier trips abroad, the rugby team encountered much resistance from the English, who felt that the female players infringed upon the "inherent" male camaraderie of the sport. The French men, on the other hand, thought it was a great idea. Also playing on the B-Side was M.I.T.'s vice president for financial operations, James J. Culliton.

The teams spent months organizing the trip and raising money by selling ice cream, T-shirts, and ads for their tour booklet. They also received support from several departmental discretionary funds and made individual contributions. Schlumberger covered their costs in Paris.

The contagious good will and high spirits of the rugby players made supporters of all those they met and assured them many places to stay when they visit again. Culliton says that he has never been prouder of M.I.T.—Faith Hruby □



## Global Economy and the Crisis in Scientific Literacy Take Center Stage in Washington

To the extent that Louis XVI commodes and rare Chinese Imperial altar tables in the lobby can ever be basic, the Madison Hotel was your basic campaign kick-off venue—exactly the sort of elegant site one would expect for the launch of the Washington phase of M.I.T.'s *Campaign for the future*.

The dinner was intimate by hotel ballroom standards—150 alumni and guests. From the cheerful chaos of intersecting conversations at the cocktail reception, on through dinner's ballentine of salmon first course, finishing with the white chocolate mousse with raspberry coulis for dessert, everything went according to plan. Not surprising.

But what quickly established this occasion as exceptional were the glare of the television lights on the podium and

the brick-wall solidity of the secret service men in dark suits stationed at the door. Secretary of State George P. Shultz, Ph.D.'49, was the keynote speaker. (*Shultz's text begins on page M.I.T. 15.*) Having an alumnus and former M.I.T. faculty member as distinguished as Shultz on the podium would have been enough to imbue the occasion with the weight and impact event organizer Herbert J. Hansell, '46, thought it deserved. But President Paul E. Gray, '54, added substantially to the evening with his own remarks on the critical need for scientific literacy.

Of course, there were lighter moments. In introducing Shultz, David S. Saxon, '41, chairman of the Corporation, noted that the speaker first held public office while a faculty member at M.I.T.,

when he served as selectman in Stow, Mass. Laughter rippled around the room at the thought of moving from the municipal concerns of a New England community to superpower summits and Middle East negotiations.

And the secretary of state expressed some surprise, tongue in cheek, that his 1978 book, *Economic Policy Behind the Headlines*, was not a best seller, since it might well have been the last hard-cover book that sold for only \$8.95. He also noted that his involvement in Stow government was a consequence of his proposals for how the community might organize its high school, an informal

(L. to r.) Albert Bottoms, Kathe Weldon, Frederick Holmes, and Peter Wood at the Washington kick-off.





## WASHINGTON KICK-OFF



reminiscence that reflected a concern for secondary education Shultz shares with President Gray.

"In blunt terms," Gray told the kick-off audience, "this country is educating generation after generation of young people who are scientifically illiterate and mathematically incompetent. The present situation is a national scandal.

"The public school system in this country may not be *entirely* responsible for public scientific illiteracy, but it will do for a start," Gray said, noting that "on the average, U.S. high school students take only one year of science. Fewer than half take three years of mathematics." Gray quoted a survey of students in 17 countries conducted by

the International Association for the Evaluation of Educational Achievement that placed 14-year-olds in the U.S. in the bottom third. Among 17-year-olds, the U.S. ranked in the bottom quartile in biology, chemistry, and physics achievement—outdone by such nations as Japan, Korea, Canada, England, Hong Kong, and Hungary.

But Gray emphasized that the responsibility to be knowledgeable about topics that impinge on everyone's life does not end with high school. "In a study reported at the 1986 AAAS meeting, pollsters found that two-thirds of adults do not understand the terms 'molecule,' 'radiation,' and 'scientific study'; three-fourths of those surveyed do not un-

derstand the term 'DNA.' "

The irrationality bred by ignorance was highlighted in the same poll, Gray reported. More than half the adults said they believed that scientists have a power that makes them dangerous—and at the same time, because the world is so complicated, they believed that they can know what is going on only by trusting leaders and "experts."

Equally worrisome, the public seems to believe, despite all the advice of the scientific community, that the strategic defense initiative (SDI) is achievable soon and that throwing enough money and researchers into the war against AIDS will produce a magic bullet, Gray observed.



**G**eorge Shultz got a serious address off to a light start, to the delight of (from far left, top of page) Kathy Strehle, President Gray, Rhoda Baruch, '48, and the rest of the kick-off audience. Enjoying the preprandial reception are (clockwise from above)

William Condrell, S.M. '47, Roberta Greene, and Jean Hansell; Dan Fink, '48, and Jordan Baruch, '47; (foreground) Reginald Griffith, '55, and Jay Hellman, '68; John Luke Kelly, '56, and Susan Miller; and event chairman Herb Hansell, '46.





## KEYNOTE ADDRESS

By the Honorable George P. Shultz, Ph.D. '49  
Secretary of State



## The Winning Hand: American Leadership and the Global Economy

Scientific illiteracy threatens the ability of this country to compete in international markets, he said. "We have a manufacturing workforce with limited ability to understand the nature of their tools, processes, and products."

Illiteracy also threatens research, as evidenced by sanctions in some communities against DNA research, against the use of experimental animals, against the use of radioisotopes and radiation in medical research, and against the expansion of life science facilities.

All this leads to a threat to the "essence of democracy," Gray said, quoting M.I.T. physicist Philip Morrison. "For the necessities of economics will eventually enforce a social division into islands of the trained, who understand enough to devise and operate an increasingly complex technology, within a sea of onlookers, bemused, indifferent, and even hostile," in Morrison's words.

The solution, said Gray, is that science and mathematics must be brought back into the mainstream of American education, and that will only happen if it becomes a priority of every level of government, the educational system, the family, and society where decisions are made that effect the educational experiences of our children.

"M.I.T.'s stake in all of this is large and growing larger," Gray said. On the receiving end, the Institute depends on the schools to prepare students for M.I.T.-level work. On the contributing end, however, M.I.T. must nurture a faculty willing to work in the public domain to generate the scientific understanding required for making wise choices about public policy. And it must make an effective case for moving scientific literacy up the scale of competing public priorities.

Gray's audience didn't need reminding that none of those activities will be accomplished without resources, which is what *Campaign for the future* is all about.—Susan Lewis □



*Following is an edited text of the keynote address by George P. Shultz, Ph.D. '49, at a dinner for M.I.T.'s Campaign for the future in Washington, D.C., on April 28. Photo: Shultz (right) was greeted by President Gray at the Madison Hotel.*

Today, we are in the midst of great controversy over our role in a world of rapidly changing technology. Some have even suggested that America is a nation in decline, that we are no longer competitive.

Have we still got what it takes?

My answer is a resounding yes. We bring to the table a winning hand.


But to play that winning hand, we must be fully engaged in the shaping of the new global economy. And "full engagement" in my dictionary means the will and the resources to lead the world

toward greater economic growth, more coordinated international economic policies, and, above all, openness.

Let me begin with the facts about America's relationship to the global economy. Number one: the American economy is increasingly part of the world economy. A long-term process of economic integration and convergence, made possible by post-war trade liberalization, has sharply reduced the importance of national borders in economic affairs. Most Americans have begun to understand this fact.

Now, fact number two: the very process of production crosses national boundaries. Economic integration has not been restricted to the exchange of goods across borders. Today's market for inputs and output is the world, and American business leaders have





grasped the opportunities presented by such integrations. Firms are establishing a wide variety of international linkages to take advantage of new technologies and markets around the globe.

In much of contemporary international trade, one branch of a firm is selling to another branch of the same firm located in a different country. According to some estimates, as much as 40 percent of total U.S. trade may be of this nature. A recent survey indicates that 88 percent of U.S. manufacturers use foreign components in their products.

**F**act number three: the globalization of production has been accompanied by the globalization of finance. For example, U.S. income from international assets has increased by \$40 to \$60 billion every five years since 1967. The Federal Reserve Bank of New York estimates that the *daily* volume of international financial flows is over \$1 trillion, or about the same as *annual* U.S. government expenditures. And by now, everyone is aware of how stock exchanges around the world react to each other with unprecedented speed.

Fact number four: the world as a whole and America in particular have benefited from the emergence of the new global economy. Trade accounts for a growing share of the national economic activity of every country. The most rapid economic growth in recent history occurred between 1950 and 1973, when trade was growing most briskly.

What was true for the world was true for America. Our markets abroad and our per capita income grew faster in the decades of most rapid international economic integration than they have in the more recent past, when the growth of world trade slowed appreciably.

All of these facts suggest to me that we are at a turning point. We can catch the curve of the future by recognizing global economic realities, by continuing to reap the benefits of integration and growth. Or we can descend and get off the curve by building new and more disruptive barriers.

Why is it difficult to make this choice? Instead of speculating about some mysterious change in our national character, I prefer to look again at the facts. We are beset today by the legacy of a severe cycle of inflation and then disinflation that has troubled the world for nearly

two decades.

Accelerating inflation in the 1970s drove real interest rates down to unsustainably low, often negative, levels—providing a powerful incentive to incur debt. Then disinflation in the 1980s pushed real interest rates to unsustainably high levels, producing a sharper-than-expected rise in the real debt-service burdens of borrowers.

This roller-coaster ride badly hurt commodity producers who were caught between debt burdens and declining prices for their products. The resulting Third World debt problem continues to exact real hardship from those least able to bear it. And the economic stagnation in the highly-indebted developing countries has reduced America's exports.

American farmers also suffered severely from the cycle. Land values skyrocketed as crop prices rose, and farmers borrowed heavily as the value of their assets increased. But as inflation was wrung out of the economy and crop prices dropped, disaster struck many farm families. [This situation] also encouraged massive agricultural subsidies, here and abroad, that have distorted international trade.

### Puzzling Response to Unemployment

On the industrial side, the rising unemployment rates that accompanied inflation in the 1970s convinced most economists that inflation is not the way to reduce unemployment. But the inflation-unemployment experiences of Japan, the United States, and Europe from 1970 to 1985 proved to be quite different. In Japan, there was little or no relationship between unemployment and either the inflation rate or overall economic activity. In the United States, we moved in the 1980s toward the lower inflation and lower unemployment patterns of the pre-1970s. In Europe, however, unemployment increased steadily, seemingly unresponsive to the rate of inflation or to economic activity.

So, if we review the legacy of the period 1970 to 1985 we find: heavily indebted developing countries; low commodity prices; and high unemployment, especially in Europe. Added to these trends were wide swings in inflation-adjusted exchange rates; bloated government spending; and large trading imbalances among the industrialized

countries of the world.

This legacy goes far to explain some of the debate about our future leadership. The vision of a new global economy, with all of its opportunities, is sometimes overshadowed by the old problems.

As secretary of state, I know that the costs of engagement are considerable. The foreign affairs budget, which is crucial to our engagement abroad, will never be popular. But that budget is used to defend our security, our economy, our political strength. It fights the drug traffickers and the terrorists. Yet in terms of real dollars, the resources committed to these activities have fallen since fiscal year '85 by almost one-third.

[To deal with these issues,] we must do what is necessary to serve the public interest, through an informed and objective understanding of the issues. Let's take this test of the public interest and grade the alternatives to full American engagement.

**I** believe that we are overextended abroad and therefore headed for irrevocable decline unless we cut our security commitments (i.e. the defense budget). It is true that the United States is no longer the preeminent power it was in 1945, when much of the world lay in ruins. But the recovery of our allies in Europe and Asia under the American security umbrella must be reckoned as one of the greatest success stories of all times. It will be a sorry day in America when we regard the good fortune of our friends as detrimental to our interests, especially since we have benefited mightily as a result of their success.

I also reject the argument that our defense effort "robs" our industry of its future competitiveness because so much of our R & D effort is defense-related. Clearly there are economies where such things happen. The Soviet Union, which spends an estimated 15 to 17 percent of its GNP on defense, is a good example. But that is not true of the American economy. Our high-technology sectors are strong, and our pattern of economic growth simply does not support the argument of a long-term, defense-related decline.

In fact, we enjoyed our highest economic growth in the 1950s and 1960s, when our military expenditures averaged 9.2 percent of the GNP, a much



*Protectionism is not an insurance policy  
against the fire of unfair competition, but an act of economic arson  
that burns down everyone's house.*

higher proportion than the 6.7 percent we spend today. Over the past 10 years we have had a slightly higher rate of growth than that of Western Europe and Japan combined, although their military expenditures take a much lower proportion of their GNPs.

I am not saying that there is a correlation between higher defense spending and growth, or lower defense spending and stagnation. I am only saying that whatever the reasons for our economic difficulties, our military and political commitments are not among them.

**C**onsider for a moment another popular argument, that protectionist legislation will cure our trade troubles.

Every member of Congress ought to reread the record of the 1920s and 1930s before voting on trade legislation: it is a sad story that cannot be retold often enough. International trade collapsed, not, in the main, because of the 1929 stock market crash, but because of protectionist policies of the 1930s designed to preserve domestic jobs.

The enlightened alliances and the open international economic system established in the post-war era nourished our freedom and planted the seeds for the spread of democracy. Now, four decades later, we are witnessing a remarkable global resurgence of democracy, thanks to the universal attractiveness of the democratic ideal. From Central America to the Philippines and Korea, from Africa to Eastern Europe, people want freedom. Freedom at home. Freedom in the work place. Freedom to choose their leaders.

Are we going to throw away this renaissance of free markets, free economies, free societies and free nations, in order to prove that we cannot learn from history? Or are we going to reject protection—procedural or otherwise—for what it is: not an insurance policy against the fire of unfair competition but an act of economic arson that eventually burns down everyone's house.

Finally, we ought to take on those who say that Americans can no longer compete. What are the signs of such fundamental weakness? The often-cited trade deficit, for example, tells us a lot about the relative growth rates, macroeconomic policies and exchange rates that existed between the U.S. and the rest of the world earlier in this decade.

But it says nothing that supports the view that U.S. manufacturing is in decline. Far from it.

U.S. manufacturing output accounts for just as large a share of our GNP as in the past. Productivity growth in manufacturing has been strong in recent years. The boom in U.S. manufacturing exports now in progress shows how competitive American factories have become once again.

So instead of abusing our self-esteem, let's not lose sight of the reality. As economist Herb Stein says, "The basic fact about the American economy is that it is very rich. It is not rich enough to do everything, but it is rich enough to do everything important. The only problem is deciding what is important." And the first thing that is important is to look out for our security.

### Three Directions for the Future

A transition to new relationships among the major economic powers is clearly under way. In this transition, the United States is showing the way and we must remain the leader—both economically and politically. But ours must be a leadership suited to the times. The productivity, income, and share of world output and trade of Japan and Europe now qualify them for much greater responsibility for maintaining and expanding the openness of the world economy.

Let me be more specific about the directions I would like to see us all take in today's global economy.

First, government does have a role in promoting more vigorous growth around the world. Every sensible person favors more economic growth. The issue, however, is the role to be played by government. Government's responsibility is to provide a stable fiscal, monetary, and legal environment, and then let markets work freely. Such an environment is critical if private entrepreneurship and innovation are to flourish.

President Reagan's insistence that the market, rather than the government, should be the principal force in economic policy has paid off. The so-called "misery index," the sum of the inflation rate and the unemployment rate, is down to single digits after more than a decade in double-digits. Employment in the United States is at an all-time high,

and nearly two-thirds of the new jobs are to be found in managerial, professional, technical, sales, or precision production operations.

Government did not produce the 15 million new jobs added to the U.S. economy since 1983—entrepreneurship did it—mostly small enterprises.

That brings me to the second direction we should all take: I call it constructive international coordination. In a world of interdependent economies, no nation can pursue successfully policies that are widely at variance with the realities of the global marketplace. Many nations have been tempted to defy this convergence. None has succeeded. That is why we are faced today with very large international economic imbalances that must be rectified.

Many have looked to the process of international coordination to ease the transition from these imbalances to a more stable economy. This is a complex undertaking which can succeed if we keep two things in mind. First, we and our trading partners must pursue the correct economic policies at home. That means we should work on root causes that interfere with the market, such as overspending, overregulation, and overtaxation by governments.

Second, coordinated international action should serve to strengthen the market and encourage those domestic policies that do the same. Coordination after all, is a process, not a panacea. It would be counterproductive if the process of international coordination reinforced wrong-headed protectionism or preserved agricultural subsidies, for example, thereby trying to repeal once more the realities of the marketplace.

**S**ome years ago I pointed out the propensity of the Japanese to save more than they invest, with the excess appearing as the net exports needed to maintain high domestic employment. Recently, the Japanese have begun to make significant adjustments—driven by the realignment of exchange rates and a new commitment to domestic growth.

Among the anomalies of our times is a Europe that seems content to live with unemployment rates above 10 percent; European social welfare systems have made unemployment almost as desirable as working. But there are costs for such policies that go beyond excessive



public spending and unproductive use of resources. Above all, there is the human tragedy. When competition in the global economy increasingly demands skill and training, no nation can neglect its youth or condemn its next generation to idleness.

Changes in policies that stunt growth are even more crucial for the developing countries with heavy debt burdens. Many debtor countries have run large trade surpluses by cutting investment and imports to the bone, not by creating the market-oriented environment that will allow exports to expand. The austerity required by such a strategy strains their political and social fabric. And as the U.S. trade balance rights itself, debtor countries will face new challenges exporting to the U.S.

There, too, we face a very complex process. One side of the coin is that economic growth requires increased investment, which comes largely from private sources. The only way to attract equity capital—not just debt rollover—is to assure an attractive investment climate. And that means structural reforms to free up markets, promote trade, and encourage entrepreneurship.

The other side of the coin is the debt problem itself. It is now clear that large increases of official foreign assistance or further exposure by commercial banks is not in the cards. I am convinced that the most creative solutions will emerge when the debtors and their private lenders work out solutions directly with the governments involved.

Third, and finally, we must all go on the offense for openness in trade, in investment, in ideas. Over the last 15 years we have found it difficult to do more than fight off destructive protectionism. That is not good enough. We have got to open markets further, lower trade barriers, and spur on the process of global economic integration.

That is why the U.S.-Canada Free Trade Agreement is so important. This historic accord establishes the world's largest international free trade area, affecting trade [volume] of about \$125 billion per year. [The agreement] will create better jobs and strengthen the economies of both countries. While the centerpiece of this agreement is the elimination of tariffs on all goods within ten years, one of the best things about

it is the new set of opportunities it provides for the rapidly expanding services sectors of both countries. This agreement also liberalizes trade in agriculture, autos, energy, and government procurement. It sets up an effective mechanism for settling disputes. The benefits for both countries will be the most powerful inducements in our ongoing multilateral and bilateral efforts to liberalize trade.

We also have before us today a tremendous opportunity to open up the global marketplace through the Uruguay Round of multilateral trade negotiations. There are several crucial areas for reform here, including the extension of international rules to promote the free flow of services and investment and the protection of intellectual property.

But I want to focus on one area: the need for major structural reform in agriculture is overwhelming. Farm programs around the world have become ever more costly to governments and consumers. The Organization for Economic Cooperation and Development (OECD) estimates that the budget costs of support systems and higher prices to consumers in member countries now approach \$150 billion annually. This cost far exceeds the benefits being transferred to farmers. Farm programs have become increasingly wasteful of resources which could be more productively employed elsewhere.

In the General Agreement on Tariffs and Trade (GATT) negotiations on agriculture we should address the root causes of such distortions—government supports and export subsidies. To achieve equilibrium in global supply and demand, the negotiations must reach agreement to reduce and eventually eliminate these distorting government policies. We must not be satisfied with patchwork solutions such as market-sharing arrangements.

A spirit of adventure, not only our material resources, has brought the U.S. into the front rank of nations. Our universities,—including M.I.T.—our industry, our farmers, our workers have set world standards. The common thread tying together these achievements is a sense of adventure, of experiment, of anticipation of the future.

And that's my message. Let's embrace that future with the zest that makes us great. Let's play [our] winning hand. □



The redolent air and vivid flora of Longwood Gardens in Kennett Square, Pa., provided an exotic setting for the April launch of M.I.T.'s *Campaign for the future* in the Philadelphia area. An abundance of Easter lilies, delphinium, and hyacinth gave alumni/ae and guests the sensation of being perfumed for life.

Speaking in his capacity as chairman of the Philadelphia Area Campaign Committee, Robert H. Campbell, S.M.'78, vice chairman of the Sun Refining and Marketing Co., provided a keynote for the evening. His message: "The need is real, the cause is just, and we can help." The Institute's status as the premier technical school in the U.S.



# Flower-Decked Opener in the City of Brotherly Love



***L**ongwood Gardens dinner under crab apple blossoms and a rose glass ceiling (far left). Philadelphia-area alumni and guests (clockwise from upper left: Barbara and Irene du Pont, '43 with National Campaign Chairman Reid Weedon, '41; Lewis Roosa, '49; William Bertolet III, '48 greets John Hull, '44; Virginia Homer and James Gassaway II, '44; John Haas, S.M. '42, honorary chairman of Philadelphia committee; Michel Besson, S.M. '60 in conversation with Gerald Hurst, '60.*

is not matched in ranking by its endowment per student or per faculty member, and the primary function of the \$550 million campaign is to redress that imbalance, he said.

President Paul E. Gray, '54, took the occasion to speak on the unique opportunity and responsibility that M.I.T. has to develop a new model of education and research that integrates science and technology with the vital concerns of society. The campaign, Gray said, is "a call to ensure . . . that the value of this university to the nation and the world remains secure."

Ensnared amidst the Longwood Gardens' myriad flowers and cacti, under the rose-glass panels of the ballroom's

vaulted ceiling, the members of the Philadelphia committee and more than 50 area alumni/ae could hardly have missed the call to contribute time and money to the cause.

Like kick-off audiences elsewhere, the Pennsylvania set had an opportunity to see a campaign video produced by Jonathan Spring, '79, a montage of evocative slides from M.I.T.'s past and present with a stirring narrative. "M.I.T. alternately deadens you with too much knowledge and leaves you alone to poke holes in the universe," Spring wrote in his video script.

Originally a tree park in the 18th Century, Longwood was purchased from its Quaker owners by the late Pierre S. du

Pont, 1890, with a view to preserving the ornamental trees. He designed the outdoor gardens and built the extensive conservatories that now house an overwhelming array of horticultural delights. The gardens are open to the public for botanical tours and special arts events, and were made available to the campaign largely through the good offices of Irene du Pont, '43, and his wife Barbara.

But even the exotic setting gave the audience no clues to the evening's grand finale—a fountain display from the terrace that amounted to a half-hour illuminated aquatic fireworks complete with musical accompaniment.—Faith Hruby □

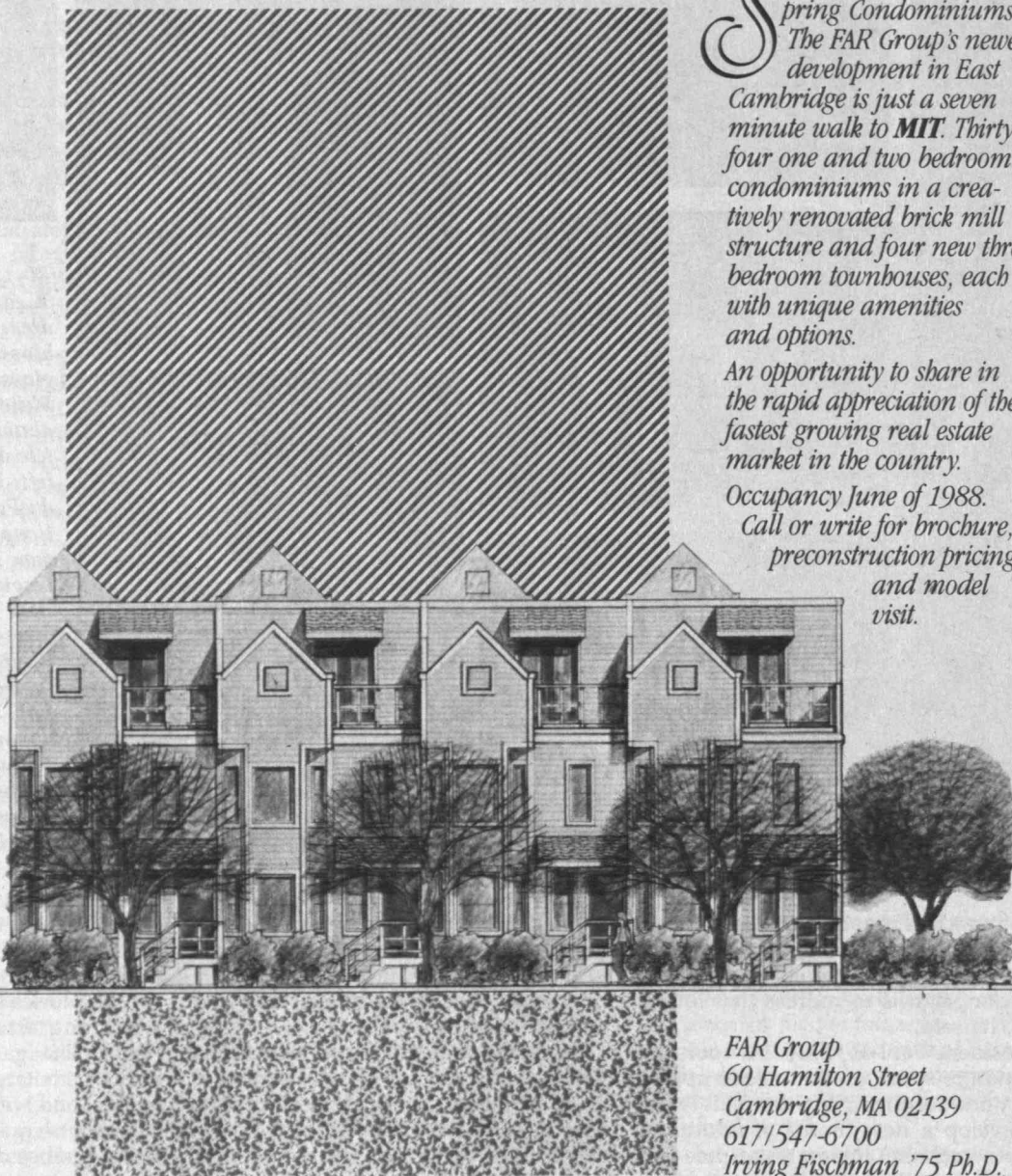


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# CLASS NOTES

07

Arthur Stowe, assistant vice-president of Connecticut National Bank in Bridgeport, Conn., sends news of **John Bradley**. He says, "He was quite pleased with the birthday card sent to him on behalf of the Institute. Mr. Bradley is well and healthy at 103 and still lives in his own home. He certainly has very pleasant feelings for his days at M.I.T. at its old campus." John Bradley celebrated his 103rd birthday last February 16. He worked for many years as a metallurgist at American Brass in Waterbury.

William Bradshaw, now living in Block Island, R.I., is M.I.T.'s oldest alumnus, at 105. He received his S.B. in chemistry.—*ed.*

16

Our thanks to **Chet Richardson** for his interesting update on his activities: "Starting with 1987—my grandson graduated from high school in June at Santa Rosa, which is about 50 miles north of San Francisco. His father, my son John, is a structural engineer working in San Francisco. He is responsible for the building of several of San Francisco's skyscrapers. My 92nd birthday was in June 1987, so I celebrated by visiting and attending my grandson's graduation. Needless to say, the celebration at the family home was quite enjoyable. He is now a freshman at the University of San Francisco. In November, son John and daughter Ruth came to visit us in Youngstown, N.Y. . . . So, with the four of us (Ruth, John, Jane, and CNR) all together, we drove to Washington, D.C., and visited the two remaining sisters of my late wife, Pearl, who died in October 1972 at age 74. Both remaining sisters are in their 80s. They and their husbands are in good shape. We had a very nice visit with the four remaining in-laws. On the way home, we visited the Corning Glass Center and saw the original casting for the 200-inch mirror of the Mt. Palomar telescope. The first casting is on display at the center. The second casting was ground and figured and was, until recently, the largest telescope in the world. On the last leg of the trip home, between Corning and Youngstown, we ran into one of the worst, heavy rainstorms that I can remember. However, we were close enough to home that Jane was familiar with the road, and we came through fine. Am currently writing my biography and will send it along as soon as it is finished." We'll look forward to receiving it, Chet, and we'll encourage other classmates to send us their life stories. Chet, we hope that you get a bountiful harvest from your cherry trees.

We were pleased to receive a copy of a commendation, issued on March 31, 1938, in Shanghai, China, from the commander-in-chief of the U.S. Asiatic Fleet, to Lt. Commander **Harold Lerner**, for outstanding performance and accomplishment in a very unique operation. Harold, now deceased, was in Course XIII. . . . We regret to report the passing of **Kenneth Eldredge Sr.**, on

## 100 years young, and full of life

By HILL LEUKHARDT

Until two years ago, John Bradley chopped wood, hiking down the hill in back of his home near Fulton Park with rope and axe in hand. If the hill was steep or the log heavy, he would get on his hands and knees to drag the wood back home. Bradley enjoyed the exercise, but finally bowed to the concerns of friends and neighbors that he do something a little less strenuous. Now he just shovels snow in winter and takes 15-minute morning walks.

None of this sounds remarkable, until one considers Bradley's age—103. When he was born on Feb. 14, 1885, the life expectancy for people was 49 years. Today, the average life span is 74. Bradley has gone 56 years beyond that.

The long-retired metallurgist outlived his wife Helen by two years, lived his adopted son Robert by several decades. Age has made inroads on him, but his tracks are not as deep as one might expect after ten decades of life.



John Bradley

"I can't hear out of my right ear and my right eye is useless," Bradley said one recent afternoon, sitting at his dining room table, sipping tea and talking with a reporter and Marge and Ernest Giglio, two friends

who help him keep house. "I have trouble reading but if I use a magnifying glass, I can do pretty well."

"John is amazing," said Mrs. Giglio, who cooks, cleans and keeps an eye on Bradley. "His mind is very sharp, he goes out for walks and he has no sickness at all. He's got a wonderful appetite. If I make it to 100, may God give me his health."

Mrs. Giglio met Bradley and his wife 50 years ago, when she lived with them during her last year of high school to work as their housekeeper.

"When I first met him, I was just a high school girl," said the gray-haired grandmother, who is in her 80s and as glad to be able to help him as he is to have her.

As she talked, Bradley looked and smiled.

"I can't bear what she's saying, but I hope she is not telling stories about me," he said. "Actually, they are good people, good friends to me. I love them."

"John," said Mrs. Giglio, "I've been saying that we treat you like you were our father."

In other words, I'm a nuisance," Ernest Giglio, who helps his wife Bradley said, laughing.

At the Bradley home, said Bradley has been showed some by age "but he is eager to get out and do things. He was mad that he no longer could chop wood. And when I went outside last week to shovel snow, he came out with me and worked."

Bradley has spent most of his long life in Waterbury, working for American Brass Co. as a metallurgist, a job he began in 1907 after receiving an engineering degree from Massachusetts Institute of Technology. He

retired in 1958.

"I worked for them until 1958, making the best brass in the world," he said. "The hardest thing in my life was being told I could no longer work for American Brass, that I was too old for them. I wanted to be a metallurgist since I was a boy and a neighbor in my hometown (the Hyde

See Page A10, 100)

*Still young and full of life, John C. Bradley, '07, has enjoyed three more birthdays since the above article was published in The Republican*

*American, Waterbury, Conn. At age 103, he lives in his own home under the care of Mr. and Mrs. Ernest Giglio. He would enjoy hearing from classmates.*

March 26, 1987.

Again, keep breathing, keep happy, and keep writing.—**Bob O'Brien**, Acting Secretary, 25 Keith Rd., Pocasset, MA 02559

17

Classmates will be sorry to learn that **Walter J. Beadle** passed away last February 8 in Kennett Square, Pa., where he and Christine had lived for many years. He was one of the class's most loyal alumni. At the time of his death, he was the most senior member of the M.I.T. Corporation.

Walter entered the institute with the class of '17 but interrupted his studies to serve overseas with the American Expeditionary Forces and participated in the Meuse-Argonne offensive in 1918. Following service with the Army of Occupation, he returned to M.I.T. and received his S.B. in mechanical engineering.

Before his long association with the E. I. du Pont de Nemours Co., he worked for the National Aniline and Chemical Co., then the Philadelphia Rapid Transit Co., joining the du Pont Co. in 1928 as a financial analyst in the Development Department. He was appointed director, vice-president, and treasurer in 1946. When he retired in 1958, he had served for a decade as a member of the company's executive committee. He remained on the board of directors until 1975.

He was active in the M.I.T. Club of Philadelphia and served as its president in 1939. He served on the Alumni Association's National Nominating Committee and was active in the Wilmington, Del., area for the Alumni Fund and for M.I.T.'s several capital campaigns. He had also served as class secretary since October 1982.

His association with the M.I.T. Corporation began in 1943 when, upon nomination by the Alumni Association, he was elected to a five-year term as an alumni term member. In 1951 he became a life member of the corporation, and in 1966, at the age of 70, became life member emeritus.

Besides his devoted service to M.I.T., Walter was involved in many local civic activities including the Franklin Institute, the Pennsylvania Academy of Fine Arts, the Philadelphia Academy of National Sciences, and the Philadelphia Figure Skating Club.

Besides his wife, Christine, he leaves three children and eight grandchildren and great-grandchildren. We, M.I.T., and the community will miss him.—**Don Severance**, Acting Secretary, 39 Hampshire Rd., Wellesley Hills, MA 02181

18

By the time you read these notes, we will have participated in our 70th reunion on the M.I.T. the





*Heading toward his centennial, Walter Muther, '13, M.I.T.'s oldest active volunteer, cuts the cake at his 98th birthday party. Old and young celebrated together last March at the Yankee Pedlar Inn in Holyoke, Mass., when the M.I.T. Club of Connecticut Valley met to hear students discuss*

*their current research in the UROP program at M.I.T. Muther has attended all recent class reunions as well as club events. Walter Smith, '28, claims there's a high correlation between coming back for reunions and longevity. This appears to be true in Walter Muther's case.*

campus. I will report on this special occasion in the October issue of the *Review*.

I noted with interest a reference in a review of the career of James R. Killian, '26 (see *Technology Review*, April 1988, p. MIT 12): "As editor of *Technology Review*, he sought contributions and advice from leading typographers and illustrators, including etcher/photographer Samuel V. Chamberlain."

We record with regret the death of **Ira R. Young** on December 30, 1987. He received his S.B. in mechanical engineering and retired in 1964 from Weymouth Art Leather Co., Braintree, Mass. He moved to Arizona in 1986. He is survived by his wife, Wilma, two daughters, a brother, two sisters, eight grandchildren, and four great-grandchildren.—**Max Seltzer**, Secretary, 865 Central Ave., Needham, MA 02192; **Leonard I. Levine**, Assistant Secretary, 519 Washington St., Brookline, MA 02146

## 19

An updated list of living graduates now shows 43 members of our 1919 class. Three members died

recently and were not previously reported in our class notes. **Oscar A. DeLima** died of a heart attack last November. Oscar and his wife Suzanne attended our last reunion (65th), and we enjoyed their company. He was an illustrious member of our class, and we shall miss him. . . . **Morton A. Smith** died December 13, 1987, at Great Barrington, Mass., reported by his daughter, Mrs. Willard E. Granger, who wrote of his pride in being a member of 1919. . . . **Conrad H. Hedin**, of Middleboro, Mass., died December 14, 1985, reported by his granddaughter Ms. Alison Smorzewski. While we regret to report these deaths, we are pleased to thank our informants. If more information comes to hand, we will pass it on to you.

We have a nice note from **Francis Weiskittel**, our most active contributor to our notes.

We wish you all a pleasant summer and will be in touch with you all soon.—**W.O. Langille**, Secretary, P.O. Box 144, Gladstone, NJ 07934 (201) 234-0690

## 20

A fine letter from **George Des Marais** of 1140 Gardner Blvd., Norton, Ohio, tells of his move from New Jersey to Ohio and of the loss of his wife, Lois, last year. George enclosed a newsletter telling of his family. He still uses his 17-year-old car, which enables him to enjoy the beautiful countryside in Ohio. George says "hopefully something of his active family doings will buoy your spirits." It certainly has and is appreciated.

A recent visit from **Buzz Burroughs** and telephone visits from **Frank Maconi** also brought me good cheer.

**Al Fraser** died last March. He was widely known for Fraser's Flowers and for his real estate development activities. He was responsible for the Fraser Medical Building in Wellesley, the first of its type around Boston. He was a town meeting member for 50 years. The Wellesley Community Center cited him as an outstanding citizen. He was also a past president of the Kiwanis Club, the Wellesley Club, and commander of the American Legion post. He leaves his wife, a son, two daughters, and three grandchildren. Al was a faithful attendant at all class affairs and never missed a reunion.

**Abe Shlager** of Center Harbor, N.H., died. He was **Bennet Groisser's** partner in Groisser and Shlager Iron Works, in Somerville, for 40 years.

I hope the class will forgive my absence from the last couple of issues of the *Review*. I had a spell in the hospital but am now back on the job.—**Harold Bugbee**, Secretary, 313 Country Club Heights, Woburn, MA 07801

## 21

It is my sad duty to report three deaths this month: **Henry R. Hatch** of Cleveland, Ohio, on October 9, 1986; **James S. Parsons** of High Point, N.C., on February 12, 1988; and **Walter W. Kittredge** of Cheshire, Conn., on February 27, 1988.

The information on **Jim Parsons** came from his wife Helga. Jim was a native of Gloversville, N.Y. He headed the Research Department of the Wall Street firm of Eastman Dillon until retirement in 1954. He served in World War I, and in World War II he was attached to the 3rd Army and Patton's general headquarters. It was his wish to bequeath his body to the Bowman Gray School of Medicine of Wake Forest University. A private memorial service was held at the family home.

The information on **Walter Kittredge** came from his son, Philip. Walter married Elinor Taylor (Simmons '22) in 1923. He was employed as an engineer for the Southern New England Telephone Co. for 33 years before retiring in 1963.

From 1966 to 1973, he was a consultant to the Cheshire Planning and Zoning Committee. An engineer without portfolio to his church in Cheshire, he was clambering around inside the church steeple one day when he discovered a plethora of dry rot. He arranged for a crane to lift off the steeple and deposit it on the town green. Said Philip, "Perhaps one could call this the 'pinnacle' of his engineering career." Walter was the third Walter Kittredge in a row.—**Sumner Hayward**, Secretary, Wellspring House E64, Washington Ave. Ext., Albany, NY 12203; **Samuel E. Lunden**, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

## 22

To our pleasurable amazement, **Martha Eiseman Munzer** continues to gather awards. She has just been elected a fellow of the Society of Women Engineers. The award was presented to Martha in June at the annual meeting of the society held in Puerto Rico. . . . **Crawford H. Greenwalt** is still on duty with the National Geographic Society, his name appearing in the masthead as trustee emeritus. . . . A note from **Lee Carol** says the



weather during their stay in Florida was poor, being cool, cloudy and windy. Lee had an opportunity to see Carlys and **Frank Kurtz**. "Frank looks much better" and Carlys is "sharp as a tack." Good news.

The class has recently lost **John M. Goodnow**, **Frank N. Houghton**, **Milton M. Manshel**, and Captain **Richard M. Rush**.

John Goodnow died March 16 at age 86 at his home in Damariscotta, Maine, to which he had moved about a year ago from his longtime home in Greenbush, Mass. He was a loyal, active alumnus, regularly attending the annual Alumni Days and all five-year reunions except our 65th, missed because of ill health. A member of Chi Phi fraternity, John went through Tech in three years, graduating at age 20. Wanting his own business, he took on a defunct family hardware company and remodeled it into the Harward Products Co., a Boston concern manufacturing specialty springs. He devised the first *Stock Spring Catalog* ever published for general use. In the '50s he designed a special spring for use in stethoscopes, which went into immediate use and is now made by 3M. Upon his retirement some 15 years ago, his two flourishing companies had been moved to Providence. Anyone who knew John can easily understand the affection his employees had for him. As a teenager John earned tuition money by drumming in a local dance band, riding to engagements with his equipment strapped to his motorcycle. He is survived by his wife, Catherine (better known to us as Steve), son John, daughter Mary, and three grandchildren.

**Milton M. Manshel** died at age 86 last December while undergoing tests in a New York hospital. This news came from Saul Copellman, who at the time of writing was in Florida on his customary seven-month winter visit. Milt for years owned and operated the very successful International Ticket Co., of which he was president and chairman of the board of directors. Milt, **Luke Walton**, **Jerome Meier**, and I had a common bond in that we all went to Barringer High School, in Newark, N.J., before heading for Cambridge. As far as I can recall, Milt came to all of our five-year reunions. He is survived by his wife, Ruth, who was with us at our 65th.

**Frank N. Houghton** of East Bridgewater, Mass., died March 9 at age 87. Before retirement he was an officer of the Arthur D. Little Co. He is survived by his wife, Miriam (Stearns), and daughter Nancy A. Jackson of Minnesota.

Captain **Richard M. Rush**, U.S. Navy, retired, of Essex, Mass., died September 26, 1987. He was in Course XIII-A and had a master's degree.

Our regrets are extended to the families of these deceased classmates.—**Yardley Chittick**, Secretary, Rte. 1, Box 396, Ossipee, NH 03864

## 23

**William Greenough, Jr.** died November 25, 1987. He attended Brown University but received his S.B. degree in aeronautical engineering at M.I.T. with our class. After graduation, he served on the staff of the Physics Department, then joined Texas Salt Co., then W. H. Coburn Co., then Greenough and Gifford, which he had purchased under the name of Moors and Cabot. He then joined Whittet-Higgins Co. and became sales manager, assistant treasurer, vice-president, president, and director.

He also was director, Skyways and Barrington Brick Co. He was a member of New England Council Aviation Committee, Providence Art Committee, University Club, Providence Shakespearean Society, Providence Athenaeum, Shop Club, and the IGWE Trust Association, the Prudential Committee of Central Congregational Church and a founding member of its Lifetime Learning Project, and the board of directors for Mary C. Wheeler School. He was president of the M.I.T. Club of Rhode Island.

**Philip Pearson** died June 10, 1987. He graduated with our class in mining engineering. After

graduation, he joined Arthur D. Little, Inc. in Cambridge, then moved to the Foxboro Co., where he became instrument engineer involving process controls. He later became manager of control valve sales, specializing in hydraulics, metallurgy, design, and application of valves and regulators. He retired in 1965—**Richard H. Frazier**, Secretary, 7 Summit Ave., Winchester, MA 01890

## 24

Retirement Home Blues! Pushing a wheelchair for stability in walking and juggling a four-pronged metal cane is a far cry from high hurdles. It is well that athletes, in their prime, think little of aging muscular elastic limits.

We have a note and obituary from Marguerite, wife of **James "Herbert" Grahame**, indicating that he died of pneumonia last October 25 in Escondido, Calif. Bert prepared at Manitoba (Canada) University. He earned his S.B. in chemical engineering, and later an L.L.B. in law. He spent his entire career with the Texas Co. as a patent attorney. During World War I, as a pilot in the Royal Air Force, he was awarded the Distinguished Flying Cross. He was a 32nd-degree Mason and a member of the Honorary Chemical Fraternity, Alpha Chi Sigma.

We got a note from Roy and Ann Trice, friends of **William A. McCartney, Jr.**, stating that he died this year. There was also a donation for unrestricted education in memory of William.

**Gene Quirin** writes: "Etienne and I have made what we hope is the final move, to the Harbour's Edge Retirement Home at 401 East Linton Blvd., Apt. 532, Delray Beach, FL 33483. Both well."

A newspaper clipping tells of the death of **Edgar Horton** on January 6 in a Cromwell Retirement Home to which he had moved from Norwell, Mass. He was awarded an S.B. in electrical engineering and for years was the engineering manager at the Submarine Signal Co. in Boston.

A newsy note from **Chris Conway** in Pineville, La., deadens the discomfort of aging. His wife, Mary recovered from a fractured pelvis and they are again active socially in New Orleans. They also spent two weeks on the New Jersey coast tasting northern shellfish.

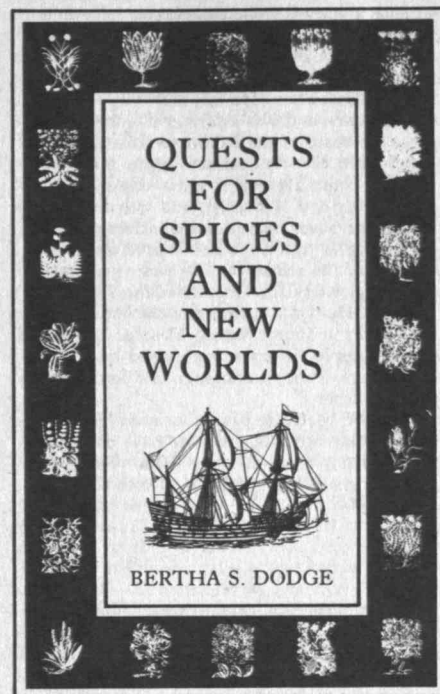
A phone call from **Hap Stern** in Palm Beach wished me improved and noted his satisfaction with southern hospitality. We understand that, before retirement, Hap was granted a full commission as a colonel in the U.S. Army.

**Al Roig** has had two years of health problems, but has enjoyed cruising. Out of New York and New Orleans he has hit Mexico, Jamaica, and the Panama Canal twice, enjoying the restored *Queen Elizabeth II* for berthing. He finds cruising very restful from his Puroto Rico business.

**Don Moore** has received several needles about producing his autobiographical compilation of the class. He promises to do something before his move to the West Coast, near his daughter, to solve driving problems.—**Russ Ambach**, Secretary, 434 Jamaica Way, Boston, MA 02130, (617) 524-6069; **Rock Hereford**, Co-secretary, Hacienda Carmel #90, Box 5397, Carmel, CA 93921, (408) 525-7590

## 25

**Temple Patton's** recovery from the stroke he suffered in May 1985 was further complicated by prostate surgery in the fall of 1987. The text, *Pigment Handbook*, which Temple wrote in 1973 was republished in 1987—Volume I only. The whole work consists of six volumes and is published by John Wiley & Sons. The magnitude of the work is matched by its price, which is about \$400. . . Letters regarding the centennial celebrations of the Department of Materials Science and Engineering in June 1988 prompted **Jesse Maury** to call and discuss the possibilities of his attending.



*For cooks wishing to add a soupçon of history to their cuisine or historians with a taste for spicy adventure, Bertha Dodge, '22, has written a new book. **Quests for Spices and New Worlds** charts the impact that a desire for exotic herbs and spices had on exploration, piracy, and colonial development. Dodge documents the fervor, as well as the squalor, that often accompanied the insatiable search for new and more—whether it be seasons, riches, or lands.*

When the department was established in 1888, it carried the simple name Department of Metallurgy. . . . A telephone call to **Courtenay Worthington** brought the information that he and Margaret had spent the month of February on the island of Antigua.

The deaths of three classmates must be reported. **Cristos Harmantas** died on December 30, 1987, at the Suburban Hospital in the Washington, D.C. area. He joined the Old Weather Bureau in 1938 as an associate meteorologist. When he retired from the weather service in 1969, he was chief of the Upper Air Engineering Division. He had represented the government at several international conferences and was a recipient of the Commerce Department's Silver Medal. He had been active in the Geophysical Union Instrument Society of America and the World Meteorological Organization and its Commission of Instruments and Methods of Observation. Christos is survived by his wife, Dena, three sons, a sister, three brothers, and three grandchildren.

**Emerson K. Patten** died of a heart attack at his home in Stoneleigh, a suburb of Baltimore, Md., on January 29, 1988. Following graduation, Emerson started work with the Chesapeake and Potomac Telephone Co. and continued with the company until retirement in 1968. At the time of his retirement, he was in the General Engineering Department as general staff supervisor of inventory and cost. Later his responsibilities were



increased to include depreciation, revenue requirements, divisions of revenue and other studies, along with plant appraisals for use in rate case testimony and engineering personnel matters. A longtime resident of Stoneleigh, Emerson was a past president of the Stoneleigh Community Association. He was active in youth organizations and was a former member of the executive board of the Baltimore Area Council of Boy Scouts. He was chairman of the boy scout camping committee for 12 years, served as a scoutmaster and cubmaster, and was awarded the boy scouts Silver Beaver award in recognition of his service to youth. He also started the Towson Chapter of the sea scouts. He was a past treasurer of the Maryland Chapter of the Telephone Pioneers. He was a member of the Towson Rotary Club and the Mount Mariah Masonic Lodge and Boumi Temple. Emerson is survived by his wife, Etta Rogers, a son, a daughter, and four great-grandchildren.

**James W. McGuire** passed away in New York City on November 29, 1987. We have no further details at this time.—**F. Leroy "Doc" Foster**, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

## 26

As of July 1986, the Alumni Association annual report says our class membership is now 252. It states that 166 of us are alumni donors, which makes 66 percent participation. This is the highest of any class. Twenty-two of our class are M.I.T. Great Dome Associates, as they gave over \$250 annually. There are eight President's Fund members who donate \$1,000 or more annually, and 22 who are life members who have contributed \$25,000 or more. There are probably more, but at their request, their names are not listed.

In the February/March issue of the, I mentioned the letter that **Juan T. Villanova** wrote to **Bill Meehan**. I wrote to him about three weeks after his letter, using the return address. This March I received my letter back from the Philippines noting that he had moved and left no forwarding address. M.I.T. has no change of address.

**Wesley C. L. Hemeon's** wife, Catherine, writes that he passed away on January 4, 1988 after four years of Parkinson's disease. They moved to Indianapolis, from Pittsburgh, Pa., four months before his death. He had been a lecturer at Harvard and the University of Pittsburgh and wrote a textbook on plant and process ventilation. He received many honors and had many connections, including the Mellon Institution. He formed Hemeon Associates, air pollution experts, and he retired in 1981.

I have been sent a fantastic list of accomplishments of our **James Killian**, but I would like to quote the description of him given by Dr. David S. Saxon, '41, retired president of the University of California and now chairman of the M.I.T. Corporation. "Few men in the 20th century have influenced the history of a major educational institution as **Dr. Killian** has influenced M.I.T. His courtly southern ways, his gentle humor, his keen insight, and his extraordinary diplomatic skills were coupled with a strong will and a fierce determination to make M.I.T. the best of its kind in the world. To the end of his life he championed M.I.T.'s causes with skill and tenacity enabled by love."

**Abraham White** died October 23, 1987. He had been living in Brookline, Mass. . . . **Henry W. Jones** of Philadelphia, Pa., who has had a full and busy life is now getting around on a walker. His autobiography, that **Bill Meehan** left us, shows a very busy and accomplished classmate with travel all over the world, including Iran. I'm sure the memory of his travels is a great blessing. . . . **Thomas D. Green's** note: "Activities: Trying to remember who, what, where, when, why and whether, possibly making life more joyful. Who knows?" His and Natalie's activities also include all reunions from 45th on. I have no records be-

fore that.—**Donald S. Cunningham**, Secretary, 27 Lowell St., Braintree, MA 02184

## 27

An example of how a normally physically fit classmate can, in the brief period of three months, discover the necessity for improved blood circulation, and undergo triple heart valve by-pass surgery, is our assistant secretary **Larry Grew**. He was 81 years, 165 lbs. and had been taking blood pressure control pills for several years. Larry gave us a summary of his ordeal: Last November he was found to be okay at his annual physical exam. At the end of December he became out of breath walking up a steep hill at his daughter's home in Pennsylvania and in January he found himself out of breath just walking home. His doctor found that his EKG was changed from his previous exam. Further tests throughout January and February proved that a triple by-pass operation was necessary. This occurred March 1 and 2.

Larry was discharged from the hospital with strict instructions. No driving. No lifting over 5 lbs. With controlled physical exertion and diet, Larry was promised to be in a stabilized condition in six weeks. Total cost about \$25,000 with Medicare covering half. This story should warn each of us to face up to exams, tests, and surgery in a timely way to save our lives.

**Richard S. Briggs** of Beverly reports he is still active as part-time consultant for MicroWave Magnetrans. "My hobby is amateur radio (W1BVL). I've kept up my contacts with friends over the years since my membership in the M.I.T. Radio Society from 1922-1927."

**Bidermann DuPont** writes that he enjoyed his first M.I.T. class reunion ever, his 60th last June. To make up for the ones he missed, he is counting on cracking the century by attending our 75th in June 2002. We all hope to celebrate with you, Ernie!

**Arthur F. Tallman**, life-long resident of Spring Valley, N.Y. died on December 5, 1987. He was employed for 40 years as an engineer for Curtis Wright Aeronautical Co. in Woodbridge N.Y., a pioneer manufacturer of variable pitch propellers. He retired in 1969 and worked for Worldwide Volkswagen until 1985.

**Hilda Young** of Gambier, Ohio, died on December 25, 1987. She was a Course IV architect who later studied under Jacques Carlu, a famous European architect. She was a marine corps veteran of World War II. Hilda was a descendant of an Ohio pioneer family and a member of the Mayflower Society.

**Joseph L. Brady** of Southbury, Conn., died on January 19, 1988, a chemical engineer in the rubber industry all of his career: Boston Woven Hose, Firestone, Fiske, U.S. Rubber, International Division, and lastly with Uniroyal Industries in Naugatuck, Conn. He travelled extensively for these companies working with foreign manufacturers of tires, tubes and footwear. He never married.

**Parry H. Moon** of Boston died at age 90 on March 4, 1988. He received his S.M. in 1927 in E.E. and joined M.I.T. as research assistant. Up to the time of his death, he and his wife, Domina, were studying electromagnetism and were still an active part of M.I.T.'s staff. This figures out to almost 61 years, truly a record life career with M.I.T.

**Frederick S. Lutz** of Orange, Conn., died on March 13, 1988. A civil engineer, he had been foundation superintendent in the construction of the Chrysler Building in New York City. He retired in 1965 as a partner with Millroy & Co. of Hamden, Conn., after being associated with the company for 20 years. Typical of M.I.T. retirees, Fred served 18 years on the Orange School Board and on the Building Committee for two schools. He was a member of the Orange Volunteer Fire Department and volunteer at Yale-New Haven Hospital. He also served as chairman of Orange

Sesquicentennial Celebration Committee.

We send our sympathy to his widow, Janet, and to the widows and families of these classmates.—**Joseph C. Burley**, Secretary, RFD 1, Ep-ping, NH 03042; **Lawrence B. Grew**, Assistant Secretary, 21 Yowago Ave., Branford, CT 06405

## 28

The reunion is still two months away as I write these notes. However, reunion preparations do generate mail thus bringing in interesting news and personal messages which I am happy to share with you. It is a kind of reunion on paper that precedes the main event.

**Carroll Smith** has written us a nice letter, mostly about the possibility of taking a river steamboat cruise. Smitty and Verna have not done much cruising but think that a riverboat trip would be about their speed. Florence and I (your secretary) took such a trip two years ago on the *Mississippi Queen* and had a thoroughly enjoyable experience. The other popular riverboat is the *Delta Queen* which, though older and somewhat smaller, is preferred by many because of its aura of charm and romance. Despite two surgical operations, Smitty still has difficulty with one knee. He plans to be in Cambridge for the 60th.

Commenting on class membership erosion, **Bion Moore** says that he is somewhat surprised to be still around. Apparently his health is good since he is hoping to drive from El Paso, Tex., to Cambridge, Mass. Possibly his daughter will accompany him. There will be stops along the way to visit friends and relatives, and Bion will end the trip by joining us at M.I.T. for the reunion. Bion's travels have included five safaris in East and South Africa, India, Bhutan, and Nepal, plus trips to Europe and Ecuador. He will bring along some slides to show his relatives and would be glad to share them with anyone else interested. We were also pleased to have Bion's professional background record which summarizes his extensive career in area studies on water and power resources for various municipal, state, and national agencies.

**Gabe Disario** plans to make the long trip from Caracas, Venezuela, to celebrate with us at M.I.T., June 1-5. His daughter, Caroline, called us by telephone from her home in Colorado to help with some of Gabe's reunion arrangements. In the course of that conversation the following set of facts came forth: Caroline herself is an M.I.T. graduate, class of '56, Caroline's husband, Russell Chihoski, is also an M.I.T. graduate, class of '54. Their daughter, Helen, graduated from the Institute in the class of '79. Tragically, their son, Russell, died before graduating from M.I.T., and his degree was awarded posthumously with the class of '83. There you have it, five M.I.T. grads in that one close family group. We salute them all!

**Mariano Contreras**, also from Caracas, Venezuela, is likewise planning to be with us at M.I.T. in June. . . . **Larry Glassman** writes that he and Ellen can admit to only a few minor ailments. They continue to be active as docents (volunteer guides) at the National Museum of American Art and at the National Air and Space Museum respectively. . . . Lucille and **Sam Weibel** enjoyed a recent group tour of Western Europe and were particularly impressed with the spring tulip blossom time in Holland and the amazing flower industry in the Amsterdam area.

We had a pleasant telephone chat with Gertrude and **Henry LaCroux** in early spring. Henry is still recovering from serious heart surgery but does go for a mile walk each day. We are glad to know that Gertrude has recovered well from her hip injury (due to a fall). During the years 1958 to 1963, they lived in Tokyo, Japan. For the last three of those years, Gertrude had the interesting position of conversational English tutor to H. M. Empress Nagako. When the royal couple from Japan visited the U.S.A. in 1975, Gertrude was given a private audience with the empress. Gertrude and Nap will be at the 60th only if his doc-



tor says "OK."

We were much pleased to receive a number of replies from our class widow group in response to the reunion mailings. At this time we can share with you the following few. Sue (Mrs. **Richard S. Smith**) writes that she is unable to be with us for the 60th but has very special memories of that commencement day of 1928. She remembers that it was a beautiful day, she and Dick (then soon to be married) were very happy and she was immensely proud of him (and still is). . . . Josephine (Mrs. **Edward M. Shiepe**) says that she will attend the reunion and looks forward to lending a hand with the hospitality corps. . . . A very pleasant note from Libby (formerly Mrs. **Stewart Newland**) tells us that she has remarried (now Mrs. Winfield Jensen) and is very happy. Libby has fond memories of the 45th and 55th reunions that she attended with Stew. To Libby and Winfield our very best wishes for many beautiful years together! We have from Asako (Mrs. **Shikao**) **Ikehara** (in Japan) a very lovely letter telling us how eager Shikao would have been to join us for reunion were he still alive. Asako had to decline the invitation we sent her but she graciously sent a contribution and promised to be with us in spirit throughout the whole schedule of events.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester MA 01890

## 29

**Charles W. Sampson** of Rochester, N.Y., writes: "We are enjoying life as best we can. During the summer months, we eat out quite a lot and take motor trips from our home to those of our children. Best regards to all our classmates." . . . Professor **Fred S. Eastman** of Medford, Ore. writes: "We moved from our old apartment to a larger one in a beautiful retirement home with a wonderful view." Fred and his wife Louise love to walk, hike, lawn bowl, and tour by car or bus with groups. Fred arranges scheduled hikes for the residents in his community.

Last March your secretary telephoned Maxine and **Milton Male**, who live near us, to say hello. They invited us to cocktails and dinner, and we spent a delightful evening with them. They have a beautiful apartment in Palm Aire (Pompano Beach), which is about eight miles south from our winter residence (Boca Pointe Country Club) on the same highway known as Power Line Road. Milton spend most of his professional life with the U.S. Steel Corp. in Pittsburgh as a structural engineer from which he retired in 1963. He took a position as a resident engineer for the American Iron and Steel Institute in Pittsburgh for seven more years and retired. About ten years ago, they moved to Florida where they are very happy. They have a son and two grandchildren who live near them and a daughter and two grandchildren in Wisconsin. They are actively involved in their condo affairs, accepting committee assignments in various phases of the organization. They have made a new circle of friends with whom they play golf, bridge, and take part in the social activities of their condo. They are well with the usual minor health problems associated with the octogenarians. They were at our 45th reunion and will try to come next year for our 60th reunion.

My wife, Helen, and I went to Parris Island, S.C., last weekend to see our grandson graduate from the Marine Corps basic training. We were tremendously impressed with the training program, and we could see a definite change in him. He seemed more confident of performing whatever task is given to him. We felt very proud that he is a part of our armed forces, which seems to attract young active men and women with high ideals.

I regret to announce the deaths of the following classmates: **John C. Macy**, of Kennelton, N.J., on February 8, 1986; and **Ralph Venzin**, of Avalon, N.J., on January 9, 1987.—**Karnig S. Dinjian**, Secretary, P.O. Box 83, Arlington, MA 02174

## 30

In Green Valley, Ariz., where Louise and I spend our winters, February and March are the most popular months for East Coast visitors. Among our recent visitors were Ruth and **Jack Latham** who, during the course of a brief holiday in Tucson, drove down for a pleasant luncheon with us. We had great fun reminiscing about the early 1930s in Charleston, W.Va., when Jack worked for Du Pont, I worked for Carbide, and for several years we shared a garage apartment. In due course Jack and Ruth got married, took over the apartment and lived in it until Jack returned to Cambridge as a Sloan Fellow. Jack is still actively involved with Haemonetics, the blood processing equipment company he founded several years ago. . . . Another recent visitor was my brother Donald, '34, who arrived the day before the Tucson M.I.T. Club held a luncheon meeting that we both attended. We were delighted to find that Margaret and **Ted Riehl** and **Paul Kimberlein** and a friend were among those present. Actually the meeting was jointly sponsored by the M.I.T., Dartmouth, and Wellesley Clubs. Since Margaret Riehl is a Wellesley alumna, the Riehls had a double reason for attending. At the luncheon Margaret passed on to me a bit of news that will be of interest to many of you. It appears that next month (April) **Jack Bennett** is scheduled to marry a Wellesley classmate of Margaret's, Eleanor "Bunny" Chichester, in Macon, Ga. Bunny and Jack have known each other for more than 50 years. They plan to live in Jack's Sanibel Island home in the winter and Bunny's Highlands, N.C., home in the summer. Since **Ralph Appleton** re-married in 1986, it is at least conceivable that we might have two newlywed couples at our 60th reunion. . . . Also present at the luncheon was Bob Blake, regional director, West, of the Alumni Association. Ted and I had a brief talk with him about preliminary reunion plans.

**George Nakashima** is still manufacturing handcrafted furniture of his own design in New Hope, Pa. His company has now become a subsidiary of Takamatsu Japan, and his furniture is sold worldwide. Several years ago he received an award of the "Third Order of the Sacred Treasure" from the government of Japan. He expects to have an exhibit of his furniture at the American Craft Museum in New York in April 1989. . . . As previously reported, **Lionel Pavlo** is president of Pavlo Engineering Co., consulting engineers specializing in the design of bridges, highways, and water and sewage treatment facilities. Among the projects his company has designed and supervised is the Commodore Barry bridge between Bridgeport, N.J., and Chester, Pa., the longest cantilever bridge in the U.S. Lionel says he is "too busy to be sick or die" and would like to have new graduates sent to him for employment interviews. His business address is now 500 Eighth Ave., New York, NY 10018.—**Gordon K. Lister**, Secretary, 294-B Heritage Village, Southbury, CT 06488

## 31

This month it is my sad duty to acknowledge three deaths: **John L. Lawson**, who passed away on December 23, 1987, and **Robert T. Leadbetter**, who passed away on June 5, 1987. The Class sends their sincere condolences to their families. For those of you who want to drop a line to their wives, I have the following home addresses: Mrs. John L. Lawson, 2052 Bruins Dr., Memphis, TN 38116; and Mrs. Robert T. Leadbetter, P.O. Box 618, Branford, CT 06405. The third death I have to report is **Francis E. Wolosewick**, who passed away on July 6, 1987. His home address was reported to be 4029 W. Warwick Ave., Chicago, IL 60641.

A note from **John Swanton** dated March 19, 1988, says: "This note on Bob Leadbetter was in the *Wisconset*, Maine, newspaper which came to

us here in Newton, but we didn't see it until recently, going over the collection of mail which accumulated during January and February, while we were on our extended trip to the West Coast. Louise and I took courage in our hands and drove out and back, visiting our daughter in Atlanta, a brother in San Diego, and another daughter in Ailver Valley, California. We went via I-10, the southern-most route and so practically avoided the winter weather and also the mountains. A delightful trip. We usually stayed under 400 miles a day. It's a fun road. Trust you and Helen are well."

No word from **Fred Elser** during the past month or so.—**Edwin S. Worden**, Secretary, P.O. Box 1241, Mount Dora, FL 32757, **John Swanton**, Assistant Secretary, 27 George St., Newton, MA 02158

## 32

As I write this, spring is in the air. 'Tis a good feeling! **Richard Stewart** writes: "My wife, Noel, and I visited **Stew Phillips** at his bachelor home on Narragansett Bay, where he has lived for 40 years. (Poison Ivy Manor, he calls it!) He is just putting it on the market and will move to 151 Tenth St. in Providence, a house he has just purchased. He will be nearer to Hamilton House, an organization for the elderly, where he has put in countless hours as an volunteer for many years. He is in good health except that he prefers not to drive after dark. (Who does?)

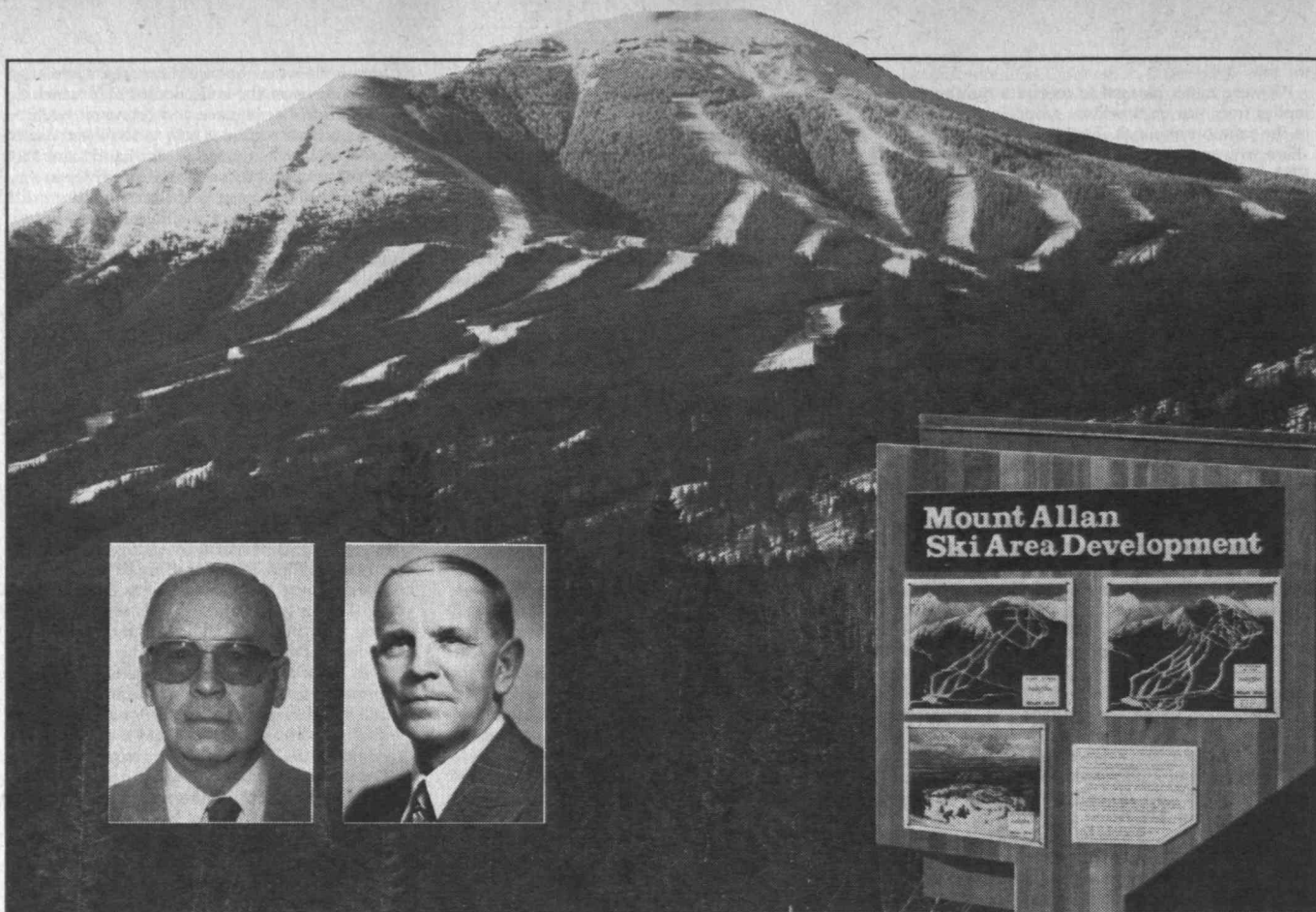
"The copper and brass industry, in which I spent virtually all my working life, has been a casualty of miniaturization, foreign imports, and the substitution of less expensive materials such as aluminum and plastics. Three of the largest—American Brass, Chase, and Scovill—all headquartered in Waterbury, have simply passed out of existence. But we have been fortunate and still live in the same house, now much too large, simply because it is easier than cleaning out the attics, cellar, and closets preparatory to moving. With the energy saved, I serve on the Development Commission, as president of the library, and as a trustee of Diocesan endowments."

**Robert Prescott** writes: "We have been to Australia and New Zealand twice since my last letter. We went in 1986 to see the comet, which was beautiful, and again in early 1987 because we enjoyed the first trip so much. New Zealand is one of the most beautiful countries in the world. . . . **Lee Tyburski** and his wife traveled this year to California and Florida, visiting their children and grandchildren. In the last few years, he has not run into any M.I.T. men, but he did meet a few shipmates of World War II. Lee, come to Technology Day next June or our next reunion and make up for lost time. . . . **Midge and William Pearce** had a good winter in Homosassa, Fla.—lots of golf, cards, and walking. As our class treasurer, he reports that all bills have been paid and we have about \$2,300 left.

**Charles Peirce** and wife Mary do a good deal of traveling, thus keeping in touch with their children and grandchildren. His son lives in Copenhagen. Charles likes to play chess with a computer. I like to play chess also! Maybe we can arrange a game by mail! . . . **Archie Riskin** has lost his wife, and he is not feeling so well these days. Our sympathy to you, Archie. We hope spring will rouse your spirits! . . . **Donald Whiston**, as we know, is also a widower. He attends Cardinal and Grey meetings. He tries to keep his house in good repair.

Doris sends us the sad news that **Elmer Stotz** died suddenly on Sunday November 22 after an apparent heart attack. He had a most distinguished career as Biochemistry Department chairman of the University of Rochester School of Medicine. He is credited as co-editor of *Comprehensive Biochemistry*, a five-volume publication on the history of biochemistry. He was known internationally and was considered a superb teacher. His main hobby was his five children, 13 grand-





Winter Olympic fans grew familiar last February with the steep slopes and high winds of Mt. Allan, site of the Alpine skiing events near Calgary, Alberta.

But probably few M.I.T. viewers knew that the peak was named in honor of John A. Allan, Ph.D.'12

(inset, above right), for his many contributions to Canadian geology. Allan was chairman of the Department of Geology at the University of Alberta from 1912 until five years before his death in 1955, and also did extensive investigation and mapping of the mineral resources of

western Canada.

News of this came from one of his sons, J. Donald Allan, Ph.D.'48 (inset, above left), who thought that alumni might be interested in the bit of M.I.T. history behind the most recently prominent of the Canadian Rockies.

children, and young people at the medical school. He was active in many organizations. As his wife said, "He was a person who said no job is too difficult."

We must also report the death of Captain **Leonard Saunders**, U.S. Navy, retired, who died after a long illness. During World War II, he was assigned to the U.S.S. *Warren* as a supply officer and gunnery officer. He made seven beachhead landings in the Pacific theater. After the war, he was active in the fishing industry, operating from Gloucester. He is survived by his widow, two sons, and eight grandchildren.

The Alumni Office informs us that **James Mackernan** died after a lengthy illness. He was an engineer with Sperry Gyroscope until his retirement. He is survived by his sisters and several nieces and nephews.—**Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

# 35

Just received a note from **Ham Dow** through the Alumni office: "My wife Edith and I have just moved to the Remington Club in Rancho Bernardo, a mile from our former home from which we moved in 1983. This is the third retirement facility (hopefully the final) since 1983. . . We are far from settled yet."

A card from **Leo Beckwith** and Marylyn let me

know that daughter Carol would be on TV with a 30-minute National Geographic Explorer story of the Wodaabe tribe in Niger taken from Carol's last book. I had given up my cable but had arranged with Pamela to go over to their house to see it. Only I came down with pneumonia which they later decided was just a wild flu attack but it kept me in bed over a week just enough to miss the March 13, 14 and 19th dates. I would appreciate anyone who did get to see it writing me about it.

**Sam Brown** fired up his computer/word processor to let me know that he and Natalie will be in Europe from May 11th to June 16th and will miss the Technology Day activities this year. Their plans include covering the area in the southwest corner of France where there is a toll road to Bilbao, Spain. Sam had a professional job there in 1971 and 1972 when the road was under construction to determine the optimum initial toll rates for everything from motorcycles to buses and trucks. From there they go eastward along the Pyrenees, the French Riviera to northern Italy's "lake country" and back to Paris through Switzerland and/or Austria. They'll be home in Pocono Springs from mid-June to September 10th, then back home to Punta Gorda, Fla. They are not rushing back to Florida because Sam ended his three years as a director and president of their Condo Association last February 9th.

I have finally decided to follow through with plans I have had for years to move to San Diego

County and terminate my living through any more New England winters! October is the month I plan to leave. There are nine '35ers in the San Diego area most of whom I have played golf with in the last 30 years that I shall be in touch with. Dry warmth and sun will be just what I can use the most of.

I discovered the brief death announcements of two of our former classmates in the *Review*: **Vito Castaldi** died September 3, 1987, in Johnston, R.I.; **George Murlin Drury** died September 20, 1985, in Portland, Oregon.—**Allan Q. Mowatt**, Secretary, P.O. Box 524, Waltham, MA 02254, (617) 899-0358

# 36

In a follow-up on the last-minute item in April Notes, **Wally Mathesius** has provided some interesting footnotes to his biography in the 50th reunion volume: "Early on, I discovered what formidable business competitors Singapore, Hong Kong and South Korea were to become, and tried to alert U.S. managements, but they paid no attention." In the process of steel plant construction in Brazil, Chile, Egypt, India, etc. his travels included "flights in a two-seater over the Andes without oxygen . . . in bush planes around Madagascar and a bit of the Australian outback . . . seven-passenger Boeings between Pittsburgh and Michigan." But no "paper-cub" flight, landing



without lights, a la **Bob Lutz**.

Like myself, Wally is first-generation American, but he has the advantage of Swedish and German forebears, and a daughter who studied in Salzburg and Munich. This and his work assignments in Western Europe have kept him fluent in several languages. When Phoebe and I motored through Germany and Austria last summer the best I could do was "Sprechen sie Englisch?" Fortunately, most young people in the larger towns did.

A card from Ted Gundlach, '40, adds to the tribute we gave to **Larry Sharpe** in April: "Larry was a favorite in Beta Theta Pi and taught many of us to fly. We drove to a small airport near Boston (Norwood?) and hired a low-wing side-by-side trainer with dual controls."

**Connie Bouchard**, Course II, in a response to the Alumni Fund, mentions touring the U.S. and Great Britain in exotic classic cars. "It all began with a 1913 Stanley Steamer I used to commute to M.I.T. (from Topsfield) during warm months." As mentioned in his reunion biography, he collects and restores Rolls, Mercedes, etc. of the period 1920-1957. By the way, President **Alice Kimball** still has a few 50th Biography volumes which she will dispense for a small contribution toward their cost. Call her at (203) 379-3807 before 8 a.m. (low rates, and she rises early) and haggle. She likes to hear from classmates, and if no answer, be persistent, because she travels a good bit.

Let's give cheers for the lives of **John Viola** and **Jack Stapler**! A note from wife Alba tells of John's death December 1, 1987 of cancer. John was Course XVII, building engineering and construction, and practiced his profession in World War II and in his career with MITRE Corp. Enlisting early, he got his choice of assignment, and went into North Africa and Italy to repair airfields, build new ones, and sometimes rebuild them as the tide of battle shifted. At the end he was back in the United States training construction G.I.s for the expected invasion of Japan. At MITRE he managed the plant and facilities until his retirement in 1980, and was rewarded for his service as Finance Chairman of his town of Westwood with a community citation. John and Alba attended several class reunions, but he was not up to making the 50th. Alice, Alba and the wives of **Bill Mullen**, **Angy Tremaglio**, and other XVIIers (who seem to have a special esprit) liked their sessions of bridge. As is apparent from his biography, John was a great family man, and Alba drew on her nursing experience to care for him at home to the end. (50 Chrystal Hill Terrace, Westwood, MA 03090)

A letter from **John Myers** tells of Jack Stapler's death February 23 after years of Parkinson's disease, which prevented his participating in our 50th. Jack retired in 1974 from National Gypsum Co., where he was general production manager. In the war he left a military desk job to get overseas, and as Lt. Colonel in the Corps of Engineers led the 1255th Battalion through the Siegfried Line, overcoming a fortified castle in Luxembourg. If it was like some mountaintop castles we saw last summer, that must have been one hell of a job. Earlier, just after graduation, Jack, John Myers and **Alden Anderson** (deceased 1975) started the Seaboard Navigation Co., transporting goods between Boston and Bangor in a converted World War I minesweeper. To quote Myers, "Jack was a driver who infected all of us with the sense that very little was impossible." So when the ship's captain, in dense Bangor fog, grounded at mid-tide on submerged piles of an old dock, the crew calmly waited out low tide by scraping barnacles, to the snapping of news cameras. There were other times when charcoal landed next to bags of sugar and when the ship drifted powerless toward rocks, heightening the adventure. One can picture our classmates enjoying (?) the experience as they learned the perils of a new business. Jack's wife Dorothy continues their residence at Bowdoinham, Maine (Box 53, Zip 04008). On the telephone she mentioned his

acquaintance with **Darby Merrill**. She sounds like a great gal who matched Jack's irrepressible spirit.

Starting the transcontinental visitations in my own backyard, I had lunch with **Philip Hart, Jr.** (Hart Sr. was also M.I.T.) who was with us for two years in Course V. **Charlie Price** and **Scott Rethorst** will remember him particularly, having been members of Theta Chi together. After sophomore year Phil could not see his future in chemistry, and transferred to Reed College, Oregon, where he set the stage for long association with music and writing. In the 1950s he was associate manager of the Chicago Symphony, and beginning in 1961 was on the administrative staff of Julliard in New York City. Lincoln Center was building then, and the Julliard unit in the planning stage. Phil was assigned to the project because, as he modestly puts it, "I was the only one at Julliard who could read a blueprint, thanks to descriptive geometry in freshman year." And, completing the M.I.T. connection, the chief architect was Pietro Bulluschi, then lately Dean of Course IV, so Phil was in Cambridge frequently to carry out his responsibilities as liaison. Over the years, and in Santa Fe since 1970, where he has served on the State Commission for the Arts, Phil has written numerous articles on music. His book *Orpheus in the New World* was published by W. W. Norton in 1973. Presently he is working on a biography of Fritz Reiner.—**Frank Phillips**, Secretary, 901 Los Lovatos, Santa Fe, NM 87501, (505) 988-2745; **James F. Patterson**, Assistant Secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

## 37

**Paul W. Allen** of Pasadena, Calif., retired March 1, 1980. His last position was executive vice-president of Cyprus Mines Corp. He is currently consulting. Wife Marge's main interest is volunteering as a docent. Paul's sports are cross-country skiing, trekking, and mountain climbing. In 1987 he made the following trips: March—cross-country skiing in France, Austria, and Norway; May-June—ditto in St. Elias Mountains of Canada's Yukon territory (camping on glaciers for three weeks); Oct.-Nov.—trekking in Bhutan up to 16,000 feet; Dec.-Jan.—travel in Chile and Antarctica. (Your secretary is exhausted just thinking about Paul's schedule.)

From Duxbury, Vt., **Harry Corman** writes: "I received your birthday greetings in Kauai, one of the Hawaiian Islands. We are staying for two months, our regular escape from the Vermont winter scene. This year we decided to try this place so that we could coordinate it with a visit to my daughter and her family in Los Angeles and my son in San Francisco. I really enjoyed the reunion. The guys were great and everybody really let their hair down. June, a comparative newcomer to the scene, felt right at home and enjoyed it tremendously. The day after the reunion we went back to Norwood, Mass., where I picked up our new 'old' acquisition, 1959 Comanche airplane. I flew it back to Vermont, where I had exclusive use of it until December when I turned it over to my brother, who has become a flying nut in his old age. So he is learning to fly this more or less complicated airplane while I bask in the Hawaiian sun. I had never been here before and this island is really a flowery paradise. There are wonderful beach areas, mountains, canyons, extinct volcano craters, forests, farmland, and the Hawaiians themselves. They are a different people. A mixture of Polynesian, Chinese, Japanese, and white. Whatever it is, it comes out beautiful. June and I visited **Albert Shulman** in Bennington, Vt., last July. I spoke to **Al Wynot** in November and I wrote to **Sidney Mank** in January. Sid is really tied up with the care of parents. His mother and mother-in-law are in their early nineties."

**Earl D. Fraser** retired in Sacramento and is still pheasant hunting with a very active Brittany

spaniel. . . . **E. T. Herbig, Jr.**, of Waterville, Minn., retired in 1965 from the E. F. Johnson Co., Waseca, Minn. He writes: "We have given up our lake home, moved into an apartment, and are retired in every sense." . . . Keithley Instruments, Inc., announced that Joseph P. Keithley was elected to the new post of vice-chairman of the maker of electronic test and measurement instruments. The election of Mr. Keithley, the 39-year-old son of **Joseph F. Keithley**, the company's 72-year-old founder and chairman, is viewed as the first step to the son's succession. "This action will provide a smooth transition of the chairman's responsibilities," said the elder Mr. Keithley, who didn't indicate when he might retire. The younger Mr. Keithley has worked in a number of capacities at the company for the past 11 years, most recently as vice-president of corporate marketing.

**Milton Lief** of St. Louis, Mo., retired February 1, 1987, from Falcon Products, Inc. He recently received a 50-year award as associate fellow of the Aerospace and Aeronautical Society. Milton has been active in city government as chairman of both the Olivette Land Clearance Authority and the Public Works Authority. He writes: "Hoppy is taking care of three granddaughters living with us. My 73rd birthday is tomorrow and we are in good health. I am looking for some consulting work to keep me busy, sharp, and away from the 'kids'." . . . **Willard Marcy** of Belham, N.Y., married Helen in 1938. Before retiring in 1983 he held the following positions: invention administration, Research Corp., New York City, vice-president (1964-1983); process development, Amstar Corp., New York City, R&D, department head (1949-1964); M.I.T., research associate (1946-1949); U.S. Army Chemical Corp., major (1942-1946); Sugar Refining, Amstar Corp., assistant refinery manager, Brooklyn (1938-1942). He has over 50 publications and two patents. He was president of the American Institute of Chemists; chairman of the AIC Student Research & Recognition Foundation, the Patent Committee of the American Chemical Society, and the editorial board of Industrial Research Institute; trustee and chairman of the Library Committee of the Chemists' Club, New York City; and leader, China-U.S. Science Exchanges. He is a member of the American Chemical Society, American Institute of Chemists (fellow), American Institute of Chemical Engineers, American Association of Advanced Science (fellow), New York Academy of Sciences (fellow), and the Chemist's Club. Hobbies are traveling, reading, archaeology, financial planning, gardening, and masonry.

**Bill Wold** of Dover, N.H., retired in 1968 from William C. Wold Associates (Transport Aircraft Sales & Leasing). He was founder, owner, and partner. Wife Louise's main interest is psychology (M.A.-Antioch). He is semi-retired, working as president of Air Land Corp. (formerly Helicopter Leasing). His hobbies are bridge, chess, tennis, and walking. His volunteer work is with the N.H. Active Retirement Association, and he teaches reading and math to illiterate adults. He is currently trying to write anecdotes and poetry. Recent travels include Texas and Missouri. . . . **Dick Young** writes: "Hobby is hole-in-one at Newport Country Club. Just learned that grandson Matt, our son Dick's older child, has been accepted at Babson, where his dad went. Makes Marge and me very happy. Plans for the 55th are starting. It should be another good time for all who make the effort to put their arms around those who found Tech important in their lives."

I regret to report the following deaths: **John G. Booton**, 74, died November 9, 1987, after a brief illness. During World War II John was employed by duPont at the Clinton, Iowa, plant, and then in Bridgeport, Conn. Later he went with Mohawk Carpet Mills in Amsterdam, N.Y., Beech-Nut in Canajoharie, N.Y., and Shulton in Clifton, N.J. He was an engineer with Champ Hats in Sunbury, Pa., when he retired. After an official retirement of about six months, he was called upon by the U.S. Government to help after hurricane Agnes and the devastating flood of 1972 in the



Susquehanna Valley. Working twelve hours a day, seven days a week, he supervised acquisition of new housing for the victims, assisted them in their requests and/or applications for federal aid, and coordinated activities of the many agencies involved. He once remarked that the assignment was the most rewarding and satisfying of his career. After his second retirement, John worked as a consulting engineer for Cobbler's Boots in Williamsport, Pa., and Masonite Corporation in Watsontown, Pa. He is survived by his wife of 43 years, Catherine Kage Booton, two daughters, Donna (Mrs. James) Carey of Williamsport, Pa., and Susan (Mrs. Robert) Zurburg, of Shamokin Dam, Pa., five grandchildren, and three great-grandchildren.

Pogo Bergen, wife of **William B. Bergen**, wrote from St. Michaels, Md., in late March in reply to my birthday letter. "Although I am interested in M.I.T. and Bill's classmates, I am deeply saddened to tell you that Bill passed away on the 9th of October following a courageous three-month bout with cancer.

**Norm Birch** wrote on April 8, 1988: "Regret to advise of the death of **Farmer Lee Current**, with whom I started Course III, then mining and metallurgy in 1933 55 years ago! And we survivors are already passed three score and ten. Farmer Lee died April 1 at Dunedin, Fla., where he and Dorothy had retired to a lovely condo apartment overlooking the broad sweep of the gulf for a number of years. Farmer Lee had trouble with failing health in recent years, but one of the most difficult to face was blindness. Then the magic of technology, lasers and lens replacement, restored his eyesight, and only ten weeks ago today (January 29) Elvie and I had a lovely leisurely lunch with them. The sun was sparkling on the boats and the waters below, and it was almost miraculous to find that Farmer could once again navigate on his own and see it all. Then suddenly, pneumonia got to him, and today we attended a small memorial service in Dunedin. He is survived by his wife Dorothy and by their children Jane and Tom."—**Lester M. Klashman**, Secretary, 289 Elm St., #71, Medford, MA 02155

## 38

Aha! I have proof that some '38ers read these notes. Remember **Ed Hadley's** suggestion on family M.I.T. connections last January? Well, **Dave Wright** writes in to say that in addition to his brother-in-law, Penn Brooks, '17, his son E. David Wright got a S.M. degree in 1982 and is now an M.D. in Burlington, Vt. Dave also reports that he and Betty are spending most of their time in Virginia in the tree nursery and cattle business.

On top of that, I received a postcard with **Burt Grosselfinger's** smiling face on it. Burt just wanted to remind me that his brother Bob was in '40 and that **Tom Bjorkman** has a brother, Sam, '39.

These notes are being written in April, so I can't report on the size of the class gift, the rain (or lack of it) on Technology Day or at Chatham Bars Inn, nor can I tell you who the class officers are, the election presumably made June 3, with recommendations offered by a nominating committee appointed by **Don Severance**—**Dave Wadleigh**, **Norm Leventhal**, and **Bob Johnson**.

**John Craig** writes from Woodbridge, Conn. that he has been retired for six years after working for the (ex) Bell system for 44 years. He keeps quite busy and, among other things, is active as deputy first selectman in Woodbridge.

A note from **Bernie Lement** in Waltham: he is still working as a materials engineering consultant, mainly in product liability and accident investigations. In March 1987 Bernie had a total hip replacement; in August he was back playing tennis better than ever.

Lastly, **Anne (Schivek) Mowat** reports that a memorial service was held last January for **Abraham Fineman**. No further details are available.—

**Armand L. Bruneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

## 39

**Jim Barton**, chairman of the class of 1939 50th reunion gift committee reports 13 committee members, 10 wives, and five guests from the M.I.T. staff met last February 9 in San Diego.

Those generating the enthusiasm and having the fun included **Mary and Jim Barton**, **Hal Chestnut**, **Billie and George Cremer**, **Jean and Mike Herasimchuk**, **Connie and Burk Kleinhofner**, **Ruth and Jim Laubach**, **Manning Morrill**, **Bill Murphy**, **Norma and Morrie Nicholson**, **Berta and Larry Perkins**, **Irv Peskoe**, **Anne and Fred Schaller**, and **Dora and Paul Stanton**.

The M.I.T. staff guests included **Bob Blake**, **Joe Collins**, **Frank McGrory**, **Marie O'Connor**, and **Diana Strange**.

For openers, **Jim Barton** asked each '39er to give a brief summary of his nearly 50 years since leaving M.I.T., some of which are reported below.

It is satisfying to know that the Class of 1939 Scholarship Fund helped five students last year and is helping three more this year.

The next committee meeting—for more fun, hard work, and sharing experiences—will be in Cambridge on September 30.

**Hal Chestnut** is active in SWIIS (Supplemental Ways for Improving International Stability). . . . **Anne and Fred Schaller's** activities are increasing in Wellesley. Their achievements are many and include reworking the four clocks in the square steeple of their church so all tell the same time. . . .

**Mike Herasimchuk** in retirement consults in steel-making, started new enterprises, and maintains a 4-8 golf handicap.

**Bill Murphy** retired from the air-conditioning business. He was taking his golf seriously until his day at San Diego was spoiled by news of Mike's low handicap. . . . **Paul Stanton** retired three times from business but is at it again—this time in carbide tools. . . . **Jim Laubach** has an accounting business and is helping people with tax counsel.

**Larry Perkins** makes boxes and guides activities in four large manufacturing plants in New England. . . . **Morrie Nicholson** retired as professor of metallurgy, and he and Norma continue their lifelong work with boy scouts. Morrie was honored recently with a "Silver Beaver" award and Norma with a first-ever "Silver Fawn" award. . . . **Manning Morrill** volunteered to be cheerleader for our 50th reunion.

**George Cremer** retired from metallurgical research and development, and some of his inventions and patents in Beryllium orbit planet Earth regularly. . . . **Leonard Mautner** writes from Pacific Palisades, Calif., "Just back from an interesting trip to Moscow/Leningrad for the 30th Anniversary of Sputnik. As guest of S.U., Marguerite and I had a good visit with cosmonauts and physicists. Got to dedicate a small computer center for young cosmonauts—gift of Raold Sagdeev, director of Soviet TKI and past Mautner lecturer (1987)."

Class president **Seymour Sheinkopf** writes: "After many years of dedicated service as class agent, **Fred Schaller** found his other duties prevent his continuing in that office. **Ernie Kaswell** volunteered to take Fred's place, and I have appointed him interim class agent." **Seymour** and **Sylvia** will travel in Great Britain via camper for four weeks this year.

**Jean and Barry Graham** were delighted when **Alicia and "Torch" Fabens** visited them in Minett, Ontario. All expect to attend our 50th. . . .

**Betty and Ryder Pratt** visit grandchildren and play golf, read, and enjoy life. **Ryder** writes, "Am interested in five companies but only spend time on one." . . . **Al Velho** retired as division vice-president, International Plants and Production, of Sterling Drug Co. **Al** writes, "My wife, Jane, is a master bridge player, and I enjoy playing at it." . . .

**Martin Lindenberg** is teaching electronics at New Bedford (Mass.) High School.

We have news of the deaths of three classmates. The *Boston Globe* reported: "**Richard P.**

**Feynman**, a Nobel laureate in physics, best-selling author and former member of the presidential commission that investigated the *Challenger* disaster, died February 15, 1988 in Los Angeles. He was a popular and energetic lecturer, member of the team that developed the first atomic bomb at Los Alamos Scientific Laboratory, and was widely known for his insatiable curiosity, gentle wit, brilliant mind, and playful temperament."

The *Montgomery* (Md.) *Journal* reported: "**Joel B. Hoberman**, an anesthesiologist, died February 5 in Bethesda."

The response to an inquiry card was a report of the death, on November 14, 1986, at Rector, Pa., of **Albert S. Roberts**. There were no details.

News such as this always saddens. But it can benefit if it reminds us to review our own estate plans. There is satisfaction in reconfirming we acted, while we still live, to recognize the persons and institutions and circumstances which contributed to increasing our capabilities and enriching our lives.—**Hal Seykota**, Secretary, 1701 Weatherswood Dr. N.W., Gig Harbor, WA 98335

## 40

A note from Class Treasurer **Edgar Bernard** updates us on class dues. He writes, "Membership fees for current year are still drifting in. These were invoiced last September. As of February 17 there are still 56 unpaid members who have been active participants in the past." If the invoice is buried on your desk, please take a moment to dig it out and send a check to Ed.

**David R. "Beano" Goodman** has had a few problems. A note from him says, "Got my right hip replaced on November 17, 1987, to try to get ready for '88 summer tennis. I'd never been in a hospital before and didn't realize how much pain they like to inflict. My first bout with a bedpan resulted in what felt like a serious attempt at emasculation, but I survived intact."

I am sorry to have to report the death of **Louis V. Russoniello**, who was killed in a single-car accident on January 7. His son writes, "One of his most long-standing activities, and one which he was very proud and happy to do, was serving as an M.I.T. educational counselor. He enjoyed the contact with young people. Also, the contact it afforded him with M.I.T. and those of you with whom he worked was a constant source of enrichment and pleasure."

**Leo Pack** sent a letter in which he says, "It was thoughtful of **Ed Bernard** to mention my interest in piping codes and standards in a recent issue of Class Notes. To this I would like to add the following: My main interest is in the reliability of piping stress calculations and their experimental verification. I have been corresponding with the American Society of Mechanical Engineers for 24 years, but I've found that sometimes they respond very slowly. My other interests are in new inventions, world disarmament, prevention of wars, human rights, listening to classical music, and occasionally observing stars and meteors.

"On the lighter side, I would like to hear from, or about, a former classmate in dormitories who was amused by a 1940 radio commercial that began, 'Ladies, do your feet hurt?' Over the years I corresponded sporadically with former teachers and students, and found that the teachers answered more readily. I hope to hear from some of you at 57 Union St., Apt. 41, Montclair, NJ 07042, or P.O. Box 137, Grand Central P.O., New York, NY 10163 (permanent)."

**Daniel Blitz** comments, "Over the years I've been too lazy to send any news regarding my activities. However, I have recently retired from Sanders Associates (now part of Lockheed), and the enclosed article from the Sanders newsletter covers most of the ground." Here are some highlights from that article. Dan retired from active service August 31, 1987. He will continue his association with the company as a consultant. After graduation, Dan joined RCA Laboratories in Camden, N.J., and later joined Raytheon's "Lab



16." In 1951 a group from this lab joined with Royden Sanders to found Sanders Associates, Inc. In a multifaceted career, Dan has been an inventor, filmmaker, and explorer. He has many technical achievements to his credit, and holds 50 U.S. patents for radar navigation and guidance systems, gyroscopes, antenna systems, signal processing, printed circuitry, data displays, and microwave equipment.

In 1955, Dan joined an expedition by Harvard University's Peabody Museum of Anthropology to study the Bushmen's Stone Age culture in Africa's Kalahari Desert. Dan served as photographer and sound recorder on the six-month trip. The expedition's film won the 1957 Flaherty Award for Best Documentary.

Dan and his wife have traveled in over 75 countries, including primitive African villages and remote Tibetan monasteries. He has written a brochure on health precautions for foreign travel, and has served as chairman of the Radio Technical Commission for Aeronautics' Special Committee, setting minimal operational performance standards for radar altimeters.

Dan is included in *Who's Who in the East* and *Who's Who in Technology Today*. He is a life member of the IEEE as well as a member of many other societies.

Keep the correspondence coming.—**Richard E. Gladstone**, Secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

## 41

**Frederick T. Davies** writes, "Since retirement, I have divided my time between Cranbury, N.J., and Little Deer Isle, Maine. In Maine I operate (?) a blueberry farm which has been mine since 1936. Last year, one of the best, resulted in a loss of \$251.20! When not in Maine or Cranbury, my wife and I do a bit of traveling. Our four sons, all married, are located as far away as Bremerton, Wash., College Station, Tex., Lake Forrest, Ill., and Raleigh, N.C.

"Within the past year I have had the pleasure of seeing Chi Phi fraternity brothers Hans Bebie, '39, **Ed Hardway**, **Ted Guething**, Bob Jevon, '43, and Perry Wilder, '43. All appear to be holding their own. Have also said hello to my good friends **Guy Slaughter**, who lives in Honolulu and **Dana Story**, who lives in Essex, Mass. Guy and Dana were Course XIII accomplices."

**Robert H. Winalki** sends us this: "Noted with great satisfaction that **Arthur Curtis** was happy, healthy, optimistic, but quit mowing his large lawn, removing snow from his hilly driveway in his 'backwood' Cochester, Conn., farm." . . . **J. Raymond Berry, Jr.** sends this gem: "In November my wife and I returned from a 30-day R.V. Caravan trip through Mexico. 3,500 miles from El Paso to San Diego, including visits to Mazatlan, Puerto Vallarta, and Cabo San Lucas. The highlight of our trip was an excursion through Copper Canyon with our motor home mounted on a flat car. Great way to see Mexico!"—**Joseph E. Dietzgen**, Secretary, Box 790, Cotuit, MA 02635

## 42

About ready to wind down a very pleasant winter here in Clearwater. By the time you get these July notes, we'll have been back in White Plains since May. In the news; **Norman Brown** was elected a Fellow of the Fluid Dynamics Division of the American Physical Society. The citation: "For his fundamental and original experimental and theoretical contributions to the understanding of fluid mechanical phenomena." . . . On a less scientific level, **George Toumanoff** was elected to the Suffolk County, N.Y., legislature and is serving on its Industrial Development Agency. . . . News from **Dick Little** is that his daughter Julia received her M.D. from Harvard Medical School last June. This is Dick's alibi for missing the 45th reunion.

**Milt Platt**, still consulting for Albany International Research, was appointed an Honorary Member of the Fiber Society, a U.S. organization devoted to the science and technology of fibrous materials and structures. . . . **Frank Staszeky** has been wintering at Rancho Mirage in California. Since retirement from Boston Edison Co., he has been doing consulting on management and on energy issues.

Newly reported retirements: **Alan MacNee** in Ann Arbor, Mich.; **Stuart Dunbar** from G.E.'s Environment Co. and from the New York State Department of Environmental Conservation at Schenectady, N.Y.; and **Russ Brown** as chief engineer of Electric Boat Division at Groton, Conn. Russ is busy as a volunteer at Mystic Seaport, lecturing at VPI and doing some "small consulting jobs."

Two obits: **Charlie Ricker** in Warren, Mich. His career included work at the National Bank of Detroit, vice-president and director of research for the First of Michigan Corp., director of the Security Bank in St. Clair Shores, member of the Detroit Free Press Board of Economists and more. Secondly, **Bill Hendrich** at Bangor, Maine. Bill was in the construction business in Buffalo and then was a structural engineer in the State of Maine for about 20 years. An active member of the Auburn Power Squadron, Bill taught celestial navigation there for many years.—**Ken Rosett**, Secretary, 191 Albemarle Rd., White Plains, NY 10605

## 43

We have an obituary notice for **Sidney L. Hall**, late president of Hall Manufacturing Co., Brookline, N.H. Sidney passed away last November 17. We extend our sympathies to his wife, Betty.

**Charles F. Chubb, Jr.**, is senior vice-president of a start-up company, Nova Technologies, in Smithtown, N.Y. Nova is developing an automatic Patient Transfer System for moving disabled persons from bed to wheelchair or commode, with the objective of enabling patients to be cared for at home, rather than in a nursing facility. Testing of prototypes is expected this year. . . . A recent letter in the *Wall Street Journal* expressed the opinion of **Ward J. Haas** that resumption of the gold standard would restore the stability and value of the dollar as an international currency. Ward is a management consultant in Southport, Conn.

From Milford, Mass., comes word that **Bill Maxwell** retired January 1, 1987. He now spends his time boating in the waters of Cape Cod and frolicking about his condominium in St. Thomas.

**Dr. Hugh E. Ramsden**, of Scotch Plains, N.J., has retired from J. T. Baker Chemical Co. to an active life of travel, gardening, visiting grandchildren, and consulting.

By the time these notes are published, we'll all be reminiscing about the great 45th reunion and what a fabulous time we had in Newport.—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

## 44

**Martin King** and wife Anne went on an animal safari trip to Kenya. They visited four preserves and had a great time photographing the animals. There also was a hot air balloon ride over the Masai-Mara National Reservation. Marty reports that even as a pilot it was quite a thrill. The high point of the trip was meeting **Bob Plachta** and wife Anne and spending time with them and reminiscing about the old days. . . . **Samuel G. Morrison** retired July 1, 1987, from Electric Boat Division of General Dynamics after 33 years with the company. He enjoys retirement but wonders when leisure begins. Church activities, historical societies, sailing a 20-foot catboat, and visiting family across the country keeps him and wife Betty busier than ever. . . . **Lawrence N. Button** has moved from Massachusetts to Sarasota, Fla., but

misses the M.I.T. Club meetings in Boston.

**Mario Banus**, Beaufort, S.C., sent a long letter at Christmas. His wife Barbara taught a course in "development sciences" at the Medical University of South Carolina in Charleston, and Mario ended up as a woodworking instructor for the same junior class. Mario also is sailing chairman at the yacht club, serves in the U.S.C.G. Auxiliary, and gardens. He spent quite some time doing carpentry work with his sons on their homes. He is looking forward to the 45th reunion.

**Chet Woodworth**, wintering in Florida, reports that he is fully recovered from a liver cancer operation and enjoying his tennis game. . . . News of the passing of **Carroll W. Boyce** from a heart attack on December 10, 1987, in Ft. Myers, Fla., was received from his wife Jean Compton Boyce. We extend our sympathy to his wife and family.

The reunion committee met last March 9 at the home of Jane and **Lou Demarkles** with **Marguerite** and **Ed Ahlberg**, **Anita** and **Leslie Brindis**, **Diane** and **Andrew Corry**, and **Ruth** and **Norm Sebell**. The 45th is all set for Bermuda as the final hotel arrangements had been completed. Norm's letter will cover the details. Keep watching for updates.—Co-secretaries: **Lou Demarkles**, 53 Maugus Hill Rd., Wellesley, MA 02181; **Andy Corry**, 16 Brimstone Lane, Sudbury, MA 01776

## 46

A trickle of odds and ends for this issue include an interesting note from **Lotfi Zadeh**, who was with us in February '46 when he received his S.M. in Course VI. He doesn't tell us what happened in the interim, but he emerged as a professor of electrical engineering and computer sciences at the University of California Berkeley, where he keeps "very busy teaching courses related to artificial intelligence and expert systems, and working on the theory of fuzzy sets and its applications, in recognition of which I was awarded an honorary doctorate by Paul Sabatier University, Toulouse, France. Although the theory is still somewhat controversial, it is finding many uses in fields ranging from industrial control to medical diagnosis."

Nice update note from **Bob Nelson** who, with wife Marianne, is still enjoying England, making friends with Rochester University (N.Y.) professor Jack Maniloff on sabbatical at Christ's College in Cambridge. He has taught Bob a lot about the English university system and its pleasant contrasts with the U.S. system. Bob would love to have our 45th take place "on a small cruise ship, probably right off the New England coast." Very nice idea. . . . A short note and nice photos from **Pauline (Glazier) Teague**, showing a record of her trip up to see **Beverly (Beane) Graham** at her beautiful Shaw Island retreat in Puget Sound. Pauline was writing just before a February trip back to Pennsylvania to visit her folks and sisters.

Combing through the bio book for names I haven't—or barely—mentioned before, I'm still finding interesting stories worth passing along.

**Dave Denzer**, a Bronx High grad and later a Course II tribesman in "our" class, very touchingly describes his frugal but full years—first at Wright Aero in N.J. and then at G.E. in Schenectady. He has lived happily with Ann since 1950, and reared two children "now cheerfully finding their own ways in this unique land of opportunity." Sorry we missed him at the 40th. Dave's priority since retiring from G.E. has been designing and building a solar home, "hopefully a valid application of the ultimate frugality."

**Kermit Greene**, a New York native and another Course II/V-12 clansman, found Elinore while at M.I.T. and married her a year or so after graduation. He also found his way into a company swallowed by Regis Paper, merged with Champion International, and now divested (returned?) to L&CP Corp. Along the way they have "seen a great deal of the world and feel very comfortable and satisfied with their family, lifestyle, and en-





*Alexander d'Arbeloff, '49, is chairman, president, and CEO of Teradyne Inc. He was named a few years ago to Electronic Business magazine's list of the ten best executives in the electronics industry. But the distinguishing feature about him that found its way into the Boston Globe recently was his extremely unpretentious office.*

*Juxtaposed in the article with the opulent aerie of an insurance company president, d'Arbeloff's doorless cubical "sets an example," he says. Although he is not particularly fond of the arrangement, it is egalitarian, and allows him and his staff to worry about their customers, not about who's got what decor. It also lets venture capitalists know where their money isn't going.*

vironment." They have two lawyer sons and an actress daughter, all living elsewhere, while they enjoy the environs of Newton Center and the Boston area in general.

**Sam Gusman**, another New Yorker (White Plains High) grad, picked up his X letter with us and his S.M. the next year. His path, after marrying Carolyn, led to Brown University where he completed his Ph.D. in physical chemistry. Joining "a large chemical company," he moved around—Pennsylvania, Ohio, and D.C. where he "became intrigued by the public-policy aspects of chemical regulation." I retired and joined a non-profit organization fostering direct communications and negotiations among the parties interested in specific environmental and natural-resource policy issues. The program—now called policy dialogue and environmental mediation—still thrives and I am still part of it. Along the way they moved to Taos, N. Mex., which, speak-

ing from experience, one can get attached to. By the time Sam reads this I'll have passed through Taos, and next time down I'll stop in.

**Sheldon Hill's** story is interesting because he started out as a pre-med V-12er, released to continue at Northwestern University, and two years later "it became clear that my future lay in something other than doctoring. . ." He transferred to Illinois University and began studying architecture. Graduating in 1951, he spent most of 1953 in Europe on a traveling fellowship, and in 1954 opened his own office in Lake Forest where he still practices. He married Betty (N.U. '61) and had three children who have graduated from New England colleges, prompting many visits down east and vicinity. In 1971 Sheldon and Betty joined nine other families in a round-the-world journey as part of their interest and involvement with the Institute of Cultural Affairs based in Chicago. This led to a year's sabbatical working with communities in Australia, Kenya, and Venezuela. Sheldon "expects to work until I drop," and looks forward to hearing from/about other classmates.

As I write this I am into my fourth day of blissful retirement. At least it will be blissful when I get this all printed and shipped.—**Jim Ray**, Secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

## 48

Plans for the 40th reunion on October 7, 8 and 9 include many opportunities to meet with classmates and exchange anecdotes and experiences. Also there will be presentations by faculty members and optional tours of M.I.T.'s campus, Boston, and New England.

The registration price includes cocktails and dinner at the Museum of Fine Arts, a formal dinner dance at Walker Memorial on Saturday night, and brunch on Sunday at the Weisner Media Center.

Last month's column provided details about our speakers—Dean Lester Thurow and Professors Ed Roberts, Woodie Flowers, and Alex Slocum. In addition, Dr. Barry Grieffe will describe his research into many individual's experiences during the transition from working to retirement. Dr. Grieffe spoke about retirement to another alumni group, and questions from the audience continued for over an hour.

Optional tours before the reunion include a visit to a northern Vermont resort. After the reunion, options include foliage tours outside Boston. You will receive separate registration forms for the various options.

**Reg Stoops** and **Margo Waite** were married in June and honeymooned in the Greek Islands. Margo is vice-president and general manager of *Cruising World* magazine. Her home is adjacent to Reg's home in Newport, R.I. They will live in Reg's home and keep Margo's house for guests.

**Bob Mueller's** article, "Mnmesethetics—Art as the Reunification of Significant Consciousness Events," was published in *Leonardo*, Volume 21, June 1988. Bob, an artist and writer, attempts to relate art to our memory of significant human consciousness events and our ability to relive them, to replay them over and over again through the media of art. Bob says he feels his M.I.T. training has propagated his bent toward theory. His son Erik received his doctorate in AI from UCLA, and his daughter Rachel will earn her doctorate in cognitive psychology from the University of Santa Cruz.

**Ralph Evans** started with the class of 1945 and, after serving as a naval pilot, graduated in 1948 with our class and was commodore of the Sailing Association. As an undergraduate, he was also a silver medalist in yachting in the 1948 summer Olympics. Active in ocean racing for many years, he won many yachting events. He has continued to support the M.I.T. Sailing Association.

During the Korean War, Ralph earned four decorations for service as a carrier pilot in the Sea of Japan. While on leave, he visited Japan

and has made five additional visits (all most enjoyable) since then. Ralph has retired as president and chairman of the board of Zotos International, Inc., but continues as a member of their board of directors. Retirement activities include interests in a New York City parking garage, a supplier of barbecue sauce, and an insurance firm. These activities are taking as much time as his job did. He also continues as a member of the corporation of the Stamford Hospital and is active with trade associations of the cosmetic industry. He is a member of M.I.T.'s Corporation Planning Committee. He and his wife, Hanna, have two sons.

**Al Baum** writes about some major changes in his life. Although his letter was addressed to me, I am taking the liberty of sharing it. I know others have experienced similar changes, and perhaps they may gain some insights from Al's experience. In 1985, he was "given the opportunity to take early retirement," from his job as manager of loss prevention for Lummus. He found it difficult to go from full speed to a dead stop. Although he thought employment for engineers in their 60s didn't exist, upon considerable pressure from his wife, Corrine, he found a job with OSHA. He says the job is quite interesting. He meets (in general) some very nice people; the work isn't too demanding; and he feels that he is making a positive contribution to some employees' safety. Al doesn't look upon the job as a career (and he feels sorry for those who do), but the job has been useful therapy at a time when he needed it.

Shortly after Al started work, Corrine had a flare-up of breast cancer from 20 years earlier. Aggressive chemotherapy was used but, despite the good fight, Corrine died. Al lost his friend, companion, helpmate, and lover of 33 years. He found the first eight months after her death almost unbearable, and he pulled in like a turtle. Having the job at OSHA was indeed fortunate, for he was able to escape his thoughts and perform some useful work. Recently, he has been meeting with a group of widowed persons and has found some inner peace and solace. He is considering joining our 40th reunion but doesn't look forward to doing it alone.

**Bob Crane** and I discussed his second coronary bypass operation 18 days after the surgery. This time the surgeon did the bypass with a mammary artery from Bob's chest instead of a vein from his leg. Bob did not bounce back as quickly after the second operation. He has signed up with a walking group that meets to walk through a local mall and will continue with a weight control program. He plans to return to work at Sterling Drug, which has been acquired by Kodak. Bob's stock options weathered the change nicely. His wife, Johnny, did not continue working after Sterling transferred Bob from Manhattan to Albany a while ago.

**Frank Jamerson** is enjoying his staff position at General Motors Research Labs, where he markets new products and processes to GM divisions. He and his wife, Joy, enjoy summers in northern Michigan and winters in Florida (vacations and weekends!). They have five children—two sons who have graduated from the Sloan School, one daughter still in college, and two sons who are married.

**Bob Hanpeter** is still going strong with Engineered Sales, Inc., in St. Louis after co-founding the company in 1965. The company is a fluid power distributor covering portions of ten midwestern states.

**Frank Jones** sold Dietz Forge, a steel forging company, and invested in Shelby, Miss., Aluminum Die Casting Co. with Japanese Associates. They are constructing a new plant in Indiana. Hobbies include ownership in a Mexican restaurant and a new company that manufactures potato chips! Frank suggests these are the result of Course XV diversification! He started to say, but then changed his mind, that he has retired three times.

**Richard Smith** is living in Sherman Oaks, Calif., and consulting in software engineering



with Litton Aero Products Division. They are working on Air Force One navigation system software quality assurance.

This column was written in Barbados, where I am spending the month of April as a volunteer for the International Executive Service Corps (IESC). I am working with Tropical Filters to improve the profitability of their manufacturing operation in Barbados. ISEC helps companies in developing nations to improve their operations by finding retired American executives to volunteer their services.

**David Freedman** has made many trips for ISEC to help bakeries. Recently, he showed a bakery in Egypt how to make brownies and chocolate chip cookies. For a while, the local bakery owner was the richest man in town, as the locals bought these newfangled pastries in great quantities. In another Egyptian city, a former palace is being converted to a five-star hotel. David helped develop the plans and equipment layout.

The executors of **Stewart Braun's** estate informed M.I.T. of Stewart's death. If you have information for an obituary, please send it for inclusion in a future column.—**Marty Billett**, Secretary, 16 Greenwood Ave., Barrington, RI 02806

## 49

Back in April I reported that **Ernest Barriere** had been retired for seven years and was living in Florida where, among other things, he was active in the General Electric Elfun. At the time, I wondered what the letters E-L-F-U-N stood for, but I miswrote and said I wished I knew what an Elfun was. Ernest explained in a letter dated March 31 that an Elfun is a member of a group of senior executives at G.E. who promote activities beneficial to citizens of all ages in the communities where the company is located. That's great and I'm glad I asked—but I still wonder what the letters stand for? Electric Lights For Unlit Nooks? Easy Lessons For Unteachable Nitwits? Executives with Leisure For Unlimited Nightcaps? Stay tuned. Maybe Ernest will write again.

**George P. Loomis** has taken early retirement (1986, at age 62) from Mogul Corp. in Chagrin Falls, Ohio, where he was vice-president for operations. However, like many of us in retirement, George is not idle. For the past year he has been working for the Delta Tau Delta Educational Foundation in Indianapolis. Says he: "It was great to learn that our M.I.T. chapter is one of our best and to learn from Paul Gray that fraternities are alive and well."

Sometimes the clippings sent out to the class secretaries are tantalizing in what they don't say. Take the one about our classmate **Jamshed Patel**. According to page 108 torn from Vol. 33, No. 2, of a professional journal, Jamshed is a newly elected fellow in the Division of Fluid Dynamics. But when this happy event occurred and which journal of which professional society was involved, the torn-out page does not say. According to my 1984 version of the *Alumni Register*, Jamshed is with Bell Labs in Murray Hill, N.J. Anyway, congratulations, Jamshed. Maybe you or someone else out there will tell us what society you are a fellow of.

This next note has me in a grammatical dither because I am writing about an event that hasn't happened yet but that will have happened by the time you read this. Grammatical difficulties aside, as I write it is April 10, two days before a supper meeting at the Institute for the New England Area Reunion Gift Sub-Committee of the Class of 1949. "What reunion gift is that?" you ask. Well, it is the one we will present to the Institute on Tech Day 1989—our 40th reunion! Generous and thoughtful alumni helped us and the Institute when we were in school. Now it's our turn. If the Institute ever helped you when you needed help, search your conscience and be cordial when one of us calls. **Tom Toohy**, chairman of the national committee, will be present to report on plans and progress in other areas of the country.

There to hear him will be the following classmates: **Jim Christopher**, **Russ Cox**, **Ira Dyer**, **Fletcher Eaton**, **Malcolm Kurth**, **Harry Lambe** (chairman), **Micky Ligor**, **Stan Margolin**, **Joe Schneider**, and **Herb Spivak**.

**John Alger** sent a delightful note, which I have altered only to the extent of inserting a bridging word here and there. He says: "Our first grandchild, born in July 1987, prompts speculation that she could rise to family 'tradition' and become a fourth-generation Tech grad in 2009. My son graduated in 1978, I did the same in 1949, and my father graduated in 1915. We all appear to have had independent reasons for applying to Tech; so, presumably, our granddaughter would find it normal by the 21st century to 'select' M.I.T. P.S. I am retiring from G.E. in Schenectady, N.Y., and plan to live in the small rural town of Rumney, N.H."

I am saddened to report the news, all too brief in some instances, of the deaths of four of our classmates. **William B. Richards**, 63, died in Santa Rosa, Calif., on July 12, 1987. He was in the investment business and is survived by his wife, Carol.

**Aldo DiMascio**, 64, died in October 1986 after a long illness. He lived in Hopewell Junction, N.Y., where he was a Systems Analyst with IBM. He is survived by his wife, Ruth, and two young children, Leslie, 19, and David, 22.

An obituary in the *Anchorage (Alaska) Times* reports that **Harry J. Lang**, 60, president and CEO of Alaska Electronics Supply, Inc., died of a heart attack June 22, 1987, at his home in Anchorage. Harry served in the Merchant Marine as an engineering officer, and then worked in various parts of the world for Hewlett-Packard before going into business in Anchorage. I well remember Harry because at our 35th reunion he received the prize for being the classmate who had come the longest distance to attend the affair.

**Samuel Rosenfield** of Lexington, Mass., died in July 1986. Regrettably, there is no further information. We, the members of the class of 1949, extend our deepest sympathies to the families of these men.—**Fletcher Eaton**, Secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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**Lester Smith** accepted "early retirement" from Hamilton Standard in Connecticut at year end 1987. Most of his career has been devoted to keeping aircraft propellers safely free from destructive vibrations. He now plans to be the curator of a local historical museum. He will continue to live in Suffield, Conn. . . . **Richard C. Brogle** of Upper Montclair, N.J., set up his own consulting company after taking early retirement from Block Drug Co. . . . **Tom Godfrey** reports from Los Alamos, N.Mex., that although his wife is planning to retire in March 1988 he is currently planning on working for a few more years. Both he and his wife are very involved in church activity both in music and administrative areas.

**Harry Rabb, Jr.**, has been with the Navy Nuclear Propulsion program since his graduation from the Institute. For the last 16 years he has been chief physicist. He still resides in Annandale, Va. . . . **Dick Haltmaier** has retired from the Draper labs in Cambridge after 37 years of service. Dick is looking forward to many trips up and down the ski slopes of Vermont. . . . **Richard Rorshach** resides in Kilgore, Texas, where he has been a lawyer in this east Texas community for many years. His two sons are Texas college graduates who are planning to work in the oil and gas business. He is looking forward to the 40th reunion and renewing old acquaintances.

**Irvine Williamson** is presently general manager of Norton RKE located in Littleton, N.H. He expects to retire sometime in 1988 and looks forward to traveling and doing a variety of interesting things. . . . **Arthur Wolpert** took early retirement after 34 years with Dupont and went

consulting for the past three years. This work has taken him to South America and Mexico. He now lives in Earleville, Md., along the beautiful shores of Chesapeake Bay. Tennis and gardening are major recreational interests. . . . **Jon Ganger**, our class treasurer, indicates that the M.I.T. Museum is interested in collecting Tech memorabilia. They are now antiques. Please look at your collection and see if you can donate it to the Museum at the 40th reunion.

**Don Ramsey** is serving this year as county commander of the Veterans of Foreign Wars in Monroe county (Rochester N.Y.). . . . **J. Harold Falcao** exports metals and ores from Brazil. He lives in Rio De Janeiro. . . . **Cosimo Cataldi** is planning on retirement from the presidency of Cynwyd Corp. this year. He then will be able to spend more time on his hobby, playing in duplicate bridge tournaments around the country.—**John T. McKenna**, Secretary, 9 Hawthorne Pl., 10H, Boston, MA 02114

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Our class president, **Bill Maini**, not content to follow the customary pattern of waiting until the immediate period preceding a class reunion, has initiated some planning activities to insure that our 40th reunion will be a very special event for both our class and for the Institute. Bill has already held several gatherings involving those of us close enough to meet and exchange ideas. From these sessions, **Marv Grossman** and Bill have agreed to cochair our reunion class gift committee. **Hank Spaulding** and **Breene Kerr** have agreed to cochair the major gifts effort.

Discussions have centered on more than just setting a monetary goal for our commemorative gift. The group is attempting to specify some tangible and meaningful benefit to the Institute that would be accomplished through our funding. This could assume a number of interesting possibilities that will be discussed with key members of the present and past heads of the Institute. We will keep you abreast of these developments through these class notes. Your thoughts and suggestions on this concept would be most welcome.

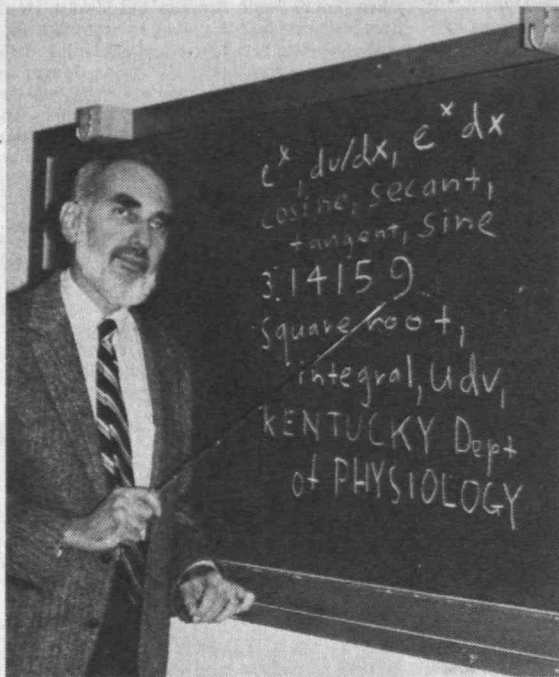
Our reunion chairman, **Harold Glenzel**, has been equally active. You have already seen some of his efforts in the form of the questionnaire sent to you last year soliciting your opinions on the form and site of our next reunion. From your responses, Harold has presented a plan having the initial portion of the reunion at the Institute so we could participate in the joint activities held with the other classes. This would be followed by a weekend of activities on Cape Cod while staying at the Chatham Bars Inn. This arrangement would comfortably accommodate our traditional clambake and evening affair, provide a place where we could be together to enjoy and renew associations, and yet avoid the excessive travel that consumed so much precious time during prior reunions. We will present more of the specifics as they develop.

Following retirement from aerospace engineering consulting with Rockwell International and Volt Technical Corporation, Col. **James O. Cobb** is now doing volunteer work for the U.S. Navy, Air Force Association, the Torrance, Calif., Armed Forces Day Exhibition, and the Order of Daedalians.

Having survived the takeover of Lear Siegler by Forstmann Little, **John W. Conley** is their director of worldwide sales/service of their truck products subsidiary. They make suspensions and spring brakes for H.O. trucks, tractors, and trailers. He is starting a major international program to take advantage of the weak American dollar.

From St. Louis, **Avrom Handleman** as CEO of Semi-Bulk Systems, is trying to change the way industry handles powders, combines them with liquids, and produces dispersions. Avrom is particularly overjoyed in having his daughter, Edna Maude, present him with their first grandchild,





*Hank Hirsch, '54, professor of psychology at the University of Kentucky, was asked by the American Psychological Society to send in a picture of himself at work in his laboratory. He is a theoretician and has no lab. So he wrote the old Tech cheer, "e<sup>x</sup>, du/dx, e<sup>x</sup>dx," on his blackboard and sent this photo.*

Spenser Trevor Gray. Avrom's wife, Claiborne, is a corporate lawyer for Union Electric. They are both well, and they welcome contacts with his classmates.

Continuing as executive director of the Bethesda PsychHealth Hospital, a nonprofit psychiatric hospital in Denver, **John B. Aycrigh** has four of his children living and working in the metropolitan Denver area. Another child is in San Francisco. John's wife, Marilyn, does volunteer work in a residential child care facility.—**Martin N. Greenfield**, Secretary, 25 Darrell Dr., Randolph, MA 02368

## 52

Last fall, **Bob Damon** and his wife and another couple from their hometown of Alton, Ill., made an archeological and theological trip to Israel. . .

**Art Freeman** traveled to New Orleans last March. A year ago I was impressed that he has given 17 papers at the March meeting of the American Physical Society. Just to show he is not slowing down, this year he gave 20, all on the electronic structure of solids. Art teaches physics at Northwestern. . . **Tom Stern** teaches at Columbia. Since his service there has been long-standing and outstanding, he has been given a chair: he is now Dicker Professor of Electrical Engineering.

Col. **Dan Lufkin** is no longer teaching astronomy at Hood College, but he is still engineering, translating, writing about computers, bicycling, and he says, generally keeping occupied.

**James Weissburg** wants more to do. After spending five years studying the accident at Three Mile Island, his assignment is completed, and he is soliciting consulting work around Pittsburgh. His son Steven, M.I.T. '77, is a patent attorney in Boston, while his younger son David, M.I.T. '85, works for Polaroid in Cambridge. His daughter Rachel was married in February and now lives in Newport News, Va. . . Another proud father, **Cliff Sayre**, says his daughter Elizabeth graduated from M.I.T. a year ago with two degrees, one in her father's field of chemical engineering and the other in humanities—"one for you, Dad, and one for me." Cliff works in transportation for DuPont, and enjoys his association with M.I.T.'s Center for Transportation Studies.

**Dave Weiss** has kindly taken the trouble to

bring us up to date on his life. After working for Booz, Allen, and Hamilton for 18 years, he joined General Electric in 1982, returning to his specialty in reliability and quality engineering. Last fall he joined University of Maryland's Engineering Research Center, a group that fosters interaction between the university and industry and helps develop centers of excellence. His three children are now ages 28 to 31. His son lives in Atlanta and his two daughters in Washington; the youngest is a Ph.D. candidate at Brown. He has been active in M.I.T.'s Educational Council for 25 years. He says it keeps him young; working on a campus makes him feel 30 years younger, too. He observes in closing that life has been good to him and his wife Connie. May it continue to be so for them, and each of you.—**Richard F. Lacey**, Secretary, 2340 Cowper St., Palo Alto, CA 94301

## 53

By the time this reaches you, our 35th reunion will just be many pleasant memories for those of us who attended. I apologize for letting the May/June deadline get past me, especially since **Dick Lindstrom** has asked me to mention that even if you weren't able to attend the reunion, please send the \$35 class dues and you will receive both the reunion memento and the results of the class questionnaire.

The following is a continuation of information garnered from responses to Dick's letter to all of us requesting information for this column on what we are doing. **T. Gerald Dyer** is vice-president and chief financial officer of Fiscal Dynamics Corp. in New Haven, Conn. . . Since the last reunion, **Maurice "Mo" Gionfriddo** has become director of the Aero-Mechanical Engineering Directorate for the U.S. Army Natick (Mass.) RD&E Center. . . **Vincent C. Verlangieri** is an advanced engineering specialist working on Special Operations Forces Programs at Lockheed. He went on to get two additional master's degrees (business economics and an M.B.A.). Vince is married to a former Simmons College graduate and has four children.

After leaving his position as assistant director of the U.S. Geological Survey two years ago to become secretary general of the 28th International Geological Congress, **Bruce B. Hanshaw** says he's having the time of his life. This July 1989 event is

expected to host 10,000 people in the U.S. who will come from all over the world. As part of his work, Bruce has been doing a lot of international travel.

We also heard from **Donald J. Jongbloed**, who informs us that he is the procurement program manager for IBM Corp., Information Systems and Products Group, in White Plains, N.Y. . . **John F. Horning** recently retired from Rocketdyne and started a second career as engineering manager for fluid products at Eaton Consolidated Controls. He and his wife, Fern, after over 33 years of marriage, enjoy traveling together both overseas and in their motor home. . . Having retired from Monsanto Co. after 31 years, **Alan T. Smith** and his wife, Edie, are now busy with their own business of selling equipment and services to people engaged in the sport of orienteering.

**James A. Zurbrigen** is in the process of retiring as president and general manager of Concrete Products Co. He will become a consultant to the concrete industry from his home near Mount Rushmore. . . **Albert W. Hecht** is manager of structures at Vertical Lift Technologies in Tempe, Ariz. . . **Stephen A. Kliment** is an editor for architecture and construction at John Wiley & Sons. . . **George J. Michel, Jr.** is chairman of the board at Stanadyne, Inc. We have a number of others we have heard from as a result of Dick's mailing, but we'll save those for our next issue. However, a few tidbits follow which were received from other sources. . . **Albert C. Lee** writes that his work on amorphous metal for a distribution transformer won the 1987 ASM Engineering Materials Achievement Award. His two oldest daughters are in college, the younger of whom completed a year at M.I.T., and his youngest daughter will start college this fall. . . **Caroline Littlejohn Herzenberg**, who is with the Argonne National Laboratory, became president of the National Association for Women in Science in January and chaired two invited sessions at the AAAS meeting in Boston this past February.

**Dr. Charles (Chuck) A. Homsey** and his wife, Ann, are continuing to work hard to keep their company, Vitek, Inc., which develops and markets innovative surgical implants, in a healthy state. He is also director of the Prosthesis Research Laboratory at the Methodist Hospital in Houston and research associate professor at Baylor College of Medicine. Their oldest son, Paul (M.I.T. '80) is doing his residency in psychiatry, while his other two children, Allan and Karen, graduated in the humanities from other schools. Also, Professor **Elliot H. Lieb** of Princeton University was awarded the 1988 Birkhoff Prize by the American Mathematical Society for "his profound analysis of problems arising in mathematical physics." . . Finally, **Richard P. Simmons**, chief executive officer of Allegheny Ludlum Steel Corp., announced a \$1 million scholarship endowment to the University of Pittsburgh for the benefit of Pittsburgh area high school students.

I will close with the sad news that **Robert J. Browne** died in January. He was a mechanical engineer for Metal Bellows of Sharon, Mass. Our sincere condolences to his wife, Marilyn.—**W. Haberman**, Secretary, 41 Crestwood Dr., Framingham, MA 01701

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**Aaron Galvin** resigned as vice-president of ADT, and started a consulting practice in Cambridge, Mass., last January. . . **Jerry Cohen** reports that he has been dean of engineering at Northwestern University since September 1986. . . **Jim Hazard** reports from Swarthmore, Pa., that he has taken up genealogy and is tracking down his ancestors, finding many interesting "characters." He reports that two of his five children are married, and another is about to be.

**Bob Warshawer**, class reunion chairman, sends word that planning is officially under way for our 35th reunion next year. The dates are June 8-11,



"with a possible extension." Mark your calendar. Activities already set include the Boston Pops on the evening of June 8, luncheon and class picture on June 9, and a visit with Priscilla and Paul Gray at the president's house on Saturday, June 10. The traditional class clambake will follow the visit. We will keep you informed as the rest of the schedule is established. Concerning his own activities, Bob reports that he retired from GTE late last year, and is now devoting his time to his custom frame shop (by appointment only) and his management consulting practice. Bob and Natalie live in Lexington, Mass., except when they are visiting their children (in Worcester, Mass., Marietta, Ga., and Midland, Mich.) and three grandchildren.—**Edwin G. Eigel, Jr.**, Secretary, 33 Pepperbush Lane, Fairfield, CT 06430; **Joseph P. Blake, Jr.**, Assistant Secretary, 74 Lawrence Rd., Medford, MA 02155

# 55



**Gordon Lohman**

**Gordon Lohman** was named executive vice-president of AMSTED Industries effective January 1, 1988. Gordon began his career with AMSTED in 1958 as a research metallurgist with the company's Griffin Wheel Division. He worked through a series of positions with the division becoming president in 1968. In 1976, Gordon was elected president of AMSTED's Macwhyte Division and was elected a corporate vice-president in 1978 and a director in 1984. He and his wife Jo Ann are the parents of two daughters and reside in Barrington Hills, Ill.

**Dennis Shapiro**, chairman of the board of Lifeline Systems, Inc., has been named director and treasurer of the American Lifeline Foundation, Inc., a publicly supported non-profit corporation dedicated to promoting quality health care for the elderly and disabled. Dennis is also a member of the board of trustees of Beth Israel Hospital in Boston, and director of the Jewish Community Housing for the Elderly, and serves on the board of the Center for Blood Research located in Boston.

**Ray Salzman** tells us that the Salzmanns are now in their fourth and final year in Brussels, still with Arthur D. Little as European director, Manufacturing Strategy/CIM. They have greatly enjoyed life in Europe these past three and one-half years, with lots of interesting travel, new friends, sights, tastes, experiences. But, they are looking forward to getting back to their original home in Carlisle, Mass., in June and getting reunited with friends, family, new grandchild, poor old dried-out boat, etc.

**Gilbert Davidson's** M.I.T. family has expanded now that his youngest daughter Sharra is a freshman at M.I.T. ('91). His other daughter Amy ('82, Course VI) has become a student again in Harvard Business School's M.B.A. program. Gilbert is vice-president and technical director of Photo-Metrics, a Route 128 R&D company, and is involved in atmospheric research.

**Bob Dyck** is the recipient of a three-year grant from USIA to support an exchange of scholars

working on dimensions of regional change in western Hungary and western Virginia. He was in Budapest during January and February 1988.

**Alan Boardman**, of Woodland Hills, Calif., has been named group vice-president, administration, at the Aerospace Corp. in El Segundo. He joined Aerospace in 1962, has directed various programs in the Engineering Group, and most recently was vice-president, Advanced Orbital Systems Operations, Development Group. After receiving his degree in aeronautical engineering from M.I.T., he took graduate courses at USC and UCLA. Aerospace is a private, nonprofit company that performs engineering, planning, analysis, and research for military space programs.

H-R International, a leading engineering and construction firm serving the chemical, petrochemical, pharmaceutical, environmental, and energy-related industries, has named **Philip J. Philliou** as project manager. During 30 years in the engineering, design, construction, and start-up of various chemical and petrochemical process plants, Philip has been responsible for several first-of-a-kind projects on which he scaled up process from the "lab pilot plant" to the operation of the commercial facility. Before joining H-R, Philip spent 28 years with the New Jersey-based Lummus Crest organization, advancing from process engineer through a series of management positions to vice-president/project director. His last assignment at Lummus Crest was as project director for a major coal-fired cogeneration facility now being built in eastern Oklahoma. Philip has been active in scouting and resides in Closter, N.J. with his wife, Marina, and four sons.

**Warren Lattoff** has seen the U.S.A. in his Chevrolet—so recently he and Charlotte joined up with their daughter, a University of Vermont senior with a semester abroad, in Kathmandu and drove through Nepal into China—Lasha, Tibet.

**Don Welsh** reports that he and Barbie are enjoying being grandparents with the arrival of their first granddaughter, Molly Ann Walkin.

Congratulations to **Ed Ehrlick** who was awarded the "Good Neighbor Award" from the National Conference of Christians and Jews, Northeast Region, at the 31st annual Good Neighbor Awards Program in Greater Boston. This is in recognition of Ed's commitments to the Chinese community in Boston adjacent to the New England Medical Center, where he is associate director.

Ed tells us that **Jim Eacker** has left The Rouse Co. and is now president of Resource Management and Development, Inc., Laurel, Md., which provides financial and project management services to individuals and firms in association with First Financial Resources, Inc. Georgia and Jim still live in the Baltimore area. Daughter Suzanne is applying to medical school, and Douglas is a senior in high school.

I regret to report that we have received word of the death of **Alan Jay Goldstein** of Livingston, N.J., in October 1986.

Thanks for all of the news this month. DuWayne and I look forward to hearing from more of you so we can continue to have full and interesting columns.—Co-secretaries: **Robert P. Greene**, 37 Great Rock Road, Sherborn, MA 01770; **DuWayne J. Peterson, Jr.**, 201 E. 79th St., New York, NY 10021

# 56

**James F. Wilson** and an American Society of Civil Engineers' subcommittee were named the winners of the 1987 ASCE State-of-the-Art of Civil Engineering Award for their paper "Dynamics of Steel Elevated Guideways—An Overview." James is a civil engineering professor at Duke University. Previously, he worked in research and development at Budd Co., U.S. Naval Ordnance, NASA-Langley, Westinghouse Atomic Power, U.S. Steel, and the U.S. Department of Transportation;

taught and conducted research at the University of Rochester and Carnegie-Mellon University; and was a Ford Fellow and a Freeman Scholar at Ohio State University where he received his doctorate. He also lectured for NATO and was visiting scholar at Colorado State University and University of Melbourne in Australia. James is an active member of the American Society of Mechanical Engineers and received the 1976 National ASME Award for his innovative experimental research in vehicle-structure dynamics.

**Dr. Terrance M. Carney** (aero/astro) is director of Electrical Engineering and Computer Applications, University of Tennessee, Chattanooga. His daughter, Laurel Carney, '83 electrical engineering, is approaching completion of her Ph.D. at the University of Wisconsin in electrical engineering with specialization in the neurophysiology of the ear. She delivered papers in England and Czechoslovakia this past summer.

**Charles M. Falco** (chemistry) was honored "for his unique and leading contributions in the area of metallic superlattices: by the American Physics Society. Charles is a fellow of the APS.

Have a good 4th and summer; will be in touch in August.—Co-secretaries: **George H. Brattin**, 39 Bartlett St., Andover, Mass. 01810, (508) 470-2730; **Irwin C. Gross**, Sweet's McGraw-Hill, 1221 Ave. of the Americas, New York, NY 10020, (212) 512-3181

# 60

This is a banner news month and I've resisted the urge to squirrel some of the items away for leaner times. Thanks to all for responding to your secretary's pleas.

One of the benefits of the secretary's job is hearing from friends near and far and renewing acquaintances. Coupled with the opportunity as class agent to pen a note on the "thank you's" for your generous Alumni Fund donations has made for busy but satisfying times.

From Elyria, Ohio, comes news that **John Beckett** has been president of the R.W. Beckett Corp. since 1965. A manufacturer of oil burners for residential heating, Beckett is celebrating its 50th anniversary. John and his wife, Wendy (Hunt), have been married 26 years and have six children, aged 13 to 25. . . . **Paul Burrow** has been honored as a fellow of the American Physical Society, Division of Atomic, Molecular, and Optical Physics, for "refinements of electron transmission spectroscopy and its innovative application to the determination of the structure, lifetimes, and energies of large molecular excited states." Congratulations, Paul! . . . While browsing in the Pentagon bookstore in early March I bumped into **Larry Elman**, who was in town for reserve duty as an Air Force colonel. Larry's "real" job is as engineer with Grumman Aircraft in Bethpage, Long Island.

A news release from Far West Financial Corp. announced the February appointment of **Fred Kayne** as president and CEO. Fred concluded a 13-year career with Bear Stearns and Co. in 1986 as managing director of their Los Angeles office. During his time with Bear Stearns, Fred was instrumental in expanding the Los Angeles office from 10 to 300 persons. Fred was also a founder and director of the First Los Angeles Bank. . . . From Phoenix I received a letter from **Ted Kraver**, a fellow Bakerite, bringing me up to date. Ted is president of Kumm Industries, a company specializing in flat belt, continuously variable transmission with the hope of becoming "the transmission of choice for 50 million cars and light trucks each year." Ted's wife, Bobbie, recently received her doctorate from Arizona State University, where his son Charles is a junior majoring in computer science. Daughter Cindy is in Dallas with EDS, and son Adam, a ninth-grader, is "on idle." Ted is also active in the Enterprise Network, a forum affiliated with the Phoenix M.I.T. Alumni Club and devoted to advancing the Arizona entrepreneurial community.





Linda  
Sprague

The November 9th issue of *Electronic News* states that **Erik Ringkjøb** is president and CEO of Digital Storage Systems in Longmont, Colo. Erik was formerly president of Intecom, Inc., a subsidiary of Wang Laboratories. . . . **Michael Rosner** reports that he was recently elected president of the Providence Hospital medical staff. Mike also continues his internal medicine-endocrinology practice in Holyoke, Mass. . . . **Morris Salame** wrote to tell me that he recently retired from Monsanto after a 28-year career there. Like it would be for most of us, retirement was not yet Morris's cup of tea, so he is now president of Polysultants, Inc., a small consulting firm specializing in packaging, plastics, and polymer science. . . . A short note from **Steve Shimberg**, who is with IBM in Columbus, Ohio, reports that son Kenneth is a member of Tech's class of '91, and daughter Jessica graduated from Brandeis in 1987.

My West Coast correspondent, who will remain anonymous for now, sent a clipping from the Decision Sciences Institute noting that **Linda Greiner Sprague** had been awarded DSI's 1987 Distinguished Service Award. Linda is a professor of business administration at the University of New Hampshire. Linda's award recognized her achievements as, *inter alia*, president, vice-president, and secretary of DSI, as well as "her success at instilling within her students appreciation for . . . the decision sciences." Congratulations from us all, Linda! . . . An article in this January's *Business Month* details **Ray Waldman's** account of how government money allows Airbus to operate at a loss and undercut U.S. manufacturers. Ray, who is Boeing Commercial Airplane Company's director of government affairs and point man on the Airbus subsidy question, was formerly an assistant secretary of commerce in the Reagan Administration. Ray has also authored a recently published book, *Managed Trade*, that details how governments restrict free trade by intervening in international economics. . . . **Rob Agronin** writes from Stamford, Conn., where he recently moved after 20 years in Wisconsin. Rob is group vice-president and COO of The Black Clawson Co., and has joined the ranks of New York commuters. Ron said one of the benefits of the move is that it brings him closer to two of his children who are attending college in the East.

Finally, this past weekend I participated in a mini-reunion here in Washington, D.C. Joining me for the weekend were **Abe Feinberg** and his wife, Vickie, Ellen and **Bob Gurnitz**, Geraldine and **Jerry Kaiz**, and Roberta and **Don Steiner**. I've recently reported on all except Don Steiner, who is an institute professor and head of the fusion program at RPI. Don joined RPI seven years ago after many years in Oak Ridge, Tenn. The Steiners have two daughters—Daniella, a student at Grinnell College, and Tova, in high school.—**Frank A. Tapparo**, Secretary, 15 South Montague St., Arlington, VA 22204

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Hoo Ray! I got a job! Some otherwise intelligent people hired me to run toxicology for EEG in

Worcester, Mass., at their Mason Research Institute. I expect to be unemployed for a grand total of one day. Never having faced the prospect of being unemployed—never looking for a job, for that matter—I have far more respect for those of you who have suffered through the experience over the years. Having M.I.T. spread all over my resume helped a lot.

Lots of people are moving around. **Tony Lamoila** who was at Polaroid as their director of chemical materials R&D has moved to the Shipley Co., in Newton, Mass., as their vice-president of R&D. Shipley makes machines which make circuit boards. This move lets Tony stay put in Sudbury where he lives with his wife and two kids. . . . **Ed Hessler** was transferred to North Haven, Conn., as vice-president and general manager of North Haven Chemical Operations. (What company, Ed?) His son, Mark, graduated from M.I.T. in June 1987.

Congratulations are in order for **Bob Pease** and **Ronald Sundelin** who have distinguished themselves in the last year. Bob writes, "As I have been staff scientist at National Semiconductor Corp. for 12 years, I decided to declare myself czar of band-gaps. In fact, in January, *Electronic Design* magazine defined my LM169 design as 'Product of the Year.'"

Ron says he was "appointed associate director, then director of the Superconducting Radio Frequency Technology Division at the Continuous Electron Beam Accelerator Facility (CEBAF) in Newport News, Va. Simultaneously, I was appointed Governor's Distinguished CEBAF Professor, affiliated with the physics department at the Virginia Polytechnic Institute and State University."

**Richard Spann** used to be president and CEO at Adage, Inc., in Billerica, Mass. Now he is chairman. I assume this is a step up but being new to the corporate world have not figured out the pecking order.

I do understand the importance of **Frank Incropera's** promotion to assistant dean of graduate education and research at Purdue. Frank is a mechanical engineer who went to Stanford for his advanced degrees and has been at Purdue ever since. Aside from his terrific research activities he is thought of as a great teacher at Purdue.—**Andrew Braun**, Secretary, 464 Heath St., Chestnut Hill, MA 02167

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A recent column from the *Sunday Greenwich* (Conn.) *Times* indicates that classmate **Gary M. Stuart** has been elected treasurer of the Union Pacific Corp., the diversified transportation and energy company that is the parent organization of the Union Pacific Railroad. Gary had previously served as assistant treasurer for Union Pacific. We always wondered what math majors from M.I.T. with M.A.s in economics from Harvard did when they went to work in industry. Gary held various financial positions with the Ford Motor Co. from 1965 to 1974, served as assistant treasurer and assistant controller with General Foods Corp. from 1974 to 1981, and joined Union Pacific in 1981, becoming assistant treasurer in 1983. Gary, his wife Sylvia, and their four children live at 274 Putnam Rd., in New Cannan, Conn.

**Harvey E. Cline** is one of the prime movers in the development of new computer software for the General Electric Co., Schenectady, N.Y. Harvey received his bachelor's degree in physics with us in 1962 and his Ph.D. in metallurgy from M.I.T. in 1965. He joined the GE Research and Development Center staff in 1965 as a metallurgist. His specialties have been eutectics, mechanical properties, and directional solidification. He is currently on the staff of the Medical Diagnostics Systems Branch, as part of the team developing a surgical planning workstation and applications for three-dimensional medical imaging. He is also the author and co-author of more than 90 technical publications and one book and holds more

than 100 U.S. patents.

**Tony Mack**, our class treasurer, has relocated to Kalamazoo, Mich., and is living the carefree bachelor life while awaiting the arrival (in June) of his family from North Reading, Mass. He is corporate development manager for Fabri-Kal Corp., a leading packaging company. . . . **Robert E. Anderson** has been named president, CEO, and COO of GenRad, Inc., Concord, Mass. He joined GenRad in 1963 and has held positions in international sales and marketing—vice-president marketing and, more recently, senior vice-president responsible for the operation of several divisions of the electronics manufacturing company. . . . **Jan Hyde** sent me a copy of the November 1987 issue of *Keepin' Track of Vettes*, a sports car magazine devoted to the Corvette. Jan is featured in a short article on page 34 called "Profile of a Vintage Corvette Race Team," with the Vette he drove across the Mass. Ave. bridge at the reunion to commemorate the measurement of the bridge in "Smoots." The article describes Jan's exploits as a member of a classic Corvette racing team at the 1987 Monterey Historic Races and at Lime Rock. While Jan has no immediate plans to race again anytime soon, the article points out that "once you've got that old racing fever. . ."

Professor **John Banzhaf** was in the news again in late March. While we're familiar with our classmate's exploits as the main spokesperson for the antismoking lobby, this time he was giving it to the president for remarks about good ol' Ollie North and his cohort John Poindexter that John called "highly inappropriate" and said they could influence jurors in the trial. John is described as "a consumer advocate who has been associated with liberal causes." And all this time we thought the antismoking campaign was a centrist view—now the national press is calling it a liberal cause.

**Albin A. Hastbacka** has been appointed vice-president, Strategic Development for E-Systems Melpar Division. In this capacity he will support the division in the development of business strategies to promote Melpar's continued growth. The appointment was announced by **Talbot S. Huff**, vice-president and general manager of the Melpar Division in Falls Church, Va. In addition to Hastbacka and Huff, **Michael E. Lee** serves as engineering manager, and **Alexander "Sandy" F. Von Kuegelgen** is manager for software development for E-Systems Melpar Division. That company could hold its own M.I.T. class of 1962 mini-reunion in Falls Church.

While we've heard about classmate **Dave Koch** as the Libertarian Party candidate for vice-president of the United States in 1980, it seems that the 1988 vice-presidential candidate for the Libertarian party is also a member of our class. **Andre Marrou** has been receiving a lot of press coverage by advocating an elimination of the federal income tax (I just love to hear that in early April of any year), decriminalizing marijuana, eliminating the legal drinking age, getting rid of public education, making property taxes optional, and removing the federal minimum wage. We wish you best of luck, Andre, especially in eliminating the federal income tax, but since I teach in a state university I'm not so sure I can be enthusiastic about trashing public education as part of the Libertarian Party platform.

Two of our classmates have received the honor of being elected fellows of the American Physical Society. **Allen Stephen Krieger** was honored "for outstanding contributions to solar astrophysics using X-ray imaging of the corona to gain an understanding of coronal structure and evolution and for establishing a firm connection between coronal holes and the high-speed solar wind."

**Roberto Daniele Peccei** was honored "for contributions to gauge theories of elementary particles, including influential studies of CP violation, axions, and majorons." I can tell how far afield my own expertise is from that of our honored classmates when I thought that Corona was a California mass-murderer, CP had something to do with the Jerry Lewis telethon, an axion was a self-evident truth (I never could spell), and that



majoron was some kind of almond-flavored cookie.

**Herschel Clopper** writes that he has been working for Polaroid for over 16 years, and has been recently named quality manager for the Optics Precision Molding Group of the Camera Division. Hersch has been singing bass with the "Gateway Guardsmen," a barbershop (harmony) chorus, and was recently elected vice-president for membership. If any of you want to sing barbershop songs and live near Framingham, write Herschel at 4 Ford Lane, Framingham, MA 01701.

**Bojey Salmon** wants to thank the 25th reunion committee for all their help. He writes: "The reunion was a tremendous success, enjoyed by all in attendance. Classmates and spouses/friends totalled more than 210 with even more when you count attendees to the youth programs. To those who attended—it was great fun, and I (Bojey) look forward to our next meeting. For those who missed it—we'd love to have you join us next time. A special thank you to those who helped contribute to a very successful 25th reunion: **Fran Berlandi, Marilyn Bever, Tom Brydges, Tony Mack, Hank McCarl, Erik Pederson, Mead Wyman, Mitch Madique, Jan Hyde, Eliza Dame (M.I.T.), Paul Johnson (M.I.T.), Lane Anderson, Art Funkhouser, Ollie Smoot, Marty Klein, Dave Koch, and Scott Burnes.**"

Bojey continues: "A special thanks to the class of '62 reunion gift committee. **Ed Linde**, chairman, and 30 classmates on the committee were successful in gaining contributions from our fellow classmates exceeding \$2.6 million. A record for M.I.T. and 25th reunion giving. We thank you all for your help and generosity."

"During the reunion we elected new officers. **Mead Wyman** will serve as class president, **Tony Mack** as treasurer, **Steve Smith** will continue into his 26th year as class agent. I (Bojey) would like to thank **John Prussing**, outgoing secretary, for his stellar performance during the past years, keeping us in touch with each other. My personal thanks to each of you for your support and participation during the past 25 years while I served as class president. I will cherish your gift of an M.I.T. chair as a frequent reminder of M.I.T., class of 1962. Have a great year."

As usual, keep those cards and letters coming in to: **Hank McCarl**, Secretary, P.O. Box 352, Birmingham, AL 35201-0352

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**Dale Miller** and his wife Kari plan a silver-anniversary sojourn at summer's end to Norway and France. Their older son Sven has completed his second year at Berkeley, including a course in Norwegian. And their second son Hans is trying to enter a military academy or ROTC program to become a pilot and aeronautical engineer. Dale himself is now doing R&D on chemically-assisted ion-beam etching and deposition for specialized solid state devices at Lawrence Livermore National Lab.

Like many others in the class, **Leland Perry** has ended up far from his original specialty. Trained as an industrial plumber (chemical engineer), he works for Allied-Signal as director of operations analysis in the corporate comptroller's office. "The changes in the company from day to day remind one of 'drinking from the fire-hose' at M.I.T." Leland lives in Mendham, N.J., and has two children in college.

**Dennis Wood** is at Boeing, where he does R&D on fiber optics for next-generation aircraft. . . .

**Kenneth Klein**, who has lived since 1982 in Atlanta (and who is "still single, but who knows?"), is founder of Soft Pedal, Inc. They design computer systems for the IBM PC and compatibles. Kenneth is an active rower, treasurer of the Atlanta Rowing Club, and competes in single sculls and fours. He is also involved in the Confederate Air Force (the what?).

I am pleased to report an important promotion for **Walter Berninger**. In January he was made

manager of the Engineering Physics Research Center within GE's R&D center. He supervises some 400 people studying automation, AI, control and quality technology, fluid and solid mechanics, etc. Previously, Walter, who now lives in Niskayuna, N.Y., has been an adjunct professor in radiology at the University of California at San Francisco and has held several positions in engineering management at G.E.

Yours truly is now sales manager at Consolidated Computer Services in suburban Baltimore. We provide accounting systems (primarily with IBM mini-computers) and related services for the construction industry.—**Phil Marcus**, Secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (301) 750-0184

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It is now less than one year till our 35th reunion. Please keep early June of next year reserved.

I regret to report that **Michael McHugh** died last December as a result of an auto accident in Troyes, France. He is survived by his wife, Chantal, and three daughters, Nadege, Valerie, and Clotilde, all of Pont Sainte Marie, France. After service as a captain with the U.S. Air Force and a number of overseas engineering assignments, Michael most recently was a partner with Composants Quartz et Electronique in Pont Sainte Marie. Our condolences go to his family.

**Doug Fleckner** has become a Life Master of the American Contract Bridge League. Doug is a self-employed investor living in Bexley, Ohio, with his wife, Jan, who is also a Life Master. . . . Speaking of bridge, **Larry Rabiner** writes that he is head of the Speech Research Department at AT&T Bell Labs, working on techniques for automatic speech and speaker recognition. Larry, who's living in Berkeley Heights, N.J., has three daughters: Sheri, going into her senior year in high school; Wendi, going into her sophomore year; and Joni, going into third grade.

**Russ Norris** sent a note commenting on a previous entry about **Bob Beardsley**, wondering if Bob still plays his long-necked banjo. Russ and Dixie are still in West Columbia, S.C., where Russ is executive minister of the South Carolina Christian Action Council. Their daughter, Claire, graduated from Johns Hopkins and is now in the Course X Ph.D. program, specializing in chemical reactor design. Russ and Dixie are hoping to be at the reunion.

**Mike Monsler** writes from Danville, Calif., where he and Barbara, his wife of 24 years and a Wellesley grad, are living with their daughter, Karin, a high-school senior. Son Eric is at UC—San Diego in the engineering program. Mike is general manager of the San Francisco operation of W. J. Schafer Associates, an advanced technology consulting company. His office is working primarily on ground-based laser technology for the Strategic Defense Initiative. Barbara is product marketing manager for Software Alliance Corp. in Berkeley. Mike occasionally sees **Tehmau Kan**, who is a laser physicist at Lawrence Livermore Laboratory and living in Orinda, Calif.

**Jay Tenenbaum** gave up managing the AI Laboratory at Schlumberger Palo Alto Research to resume active research in the areas of computer vision and applications of AI to engineering and manufacturing. He was appointed a Schlumberger Fellow (one of only two named corporate-wide). Jay was also appointed a consulting professor of computer science at Stanford University.

Among the 1987 Class of Fellows of ASM International are **Robert Mehrabian**, "in recognition of unique contributions to the understanding of the phenomena associated with the rapid solidification of metallic materials," and **John Morris**, "for outstanding contributions to the understanding and development of alloys for cryogenic service and for superconducting magnets." Bob is dean of the College of Engineering at UC—Santa Barbara. John is in the Department of Materials Science

and Mineral Engineering at UC—Berkeley.

**Antony Heatwole** is an assistant vice-president with Hughes Network Systems (a division of M/A-COM acquired by Hughes Aircraft) in Germantown, Md. He is working on systems engineering and software development for packet switching systems; Antony and his wife, Janet, have a (previously unreported) daughter, Amanda, born in March 1986. He notes that he has become an avid "birder" in the last few years, although with two small children doesn't find much free time to devote to it.

Speaking of free time, I hope that our classmates who can read but haven't yet written will use some and send me a note. Thanks.—**Joe Kasper**, Secretary, 3502 Idaho Ave., NW, Washington, DC 20016

## 65

The Alumni Fund seems to have started its fall drive, because this month's package of envelopes was actually thick. Enjoy!

**Doug Spreng** writes that he's been promoted to general manager, Commercial Systems Group at Hewlett-Packard. He's responsible for coordinating the worldwide activities of the HP3000 and HP9000 computer product lines in business applications. . . . Continuing with the computer industry, **Calvin Cordulack** writes that he's still with IBM as manager of financial services for the National Distribution Division. Cal's also investing in real estate, doing some construction, and living on Stamford Harbor with his second wife and five kids (three his) aged 15-21. He says "life is good." . . . A brief note from **John Wilson** reports that he's now working for Digital Equipment in Marlboro, living in Somerville, and taking courses towards a master's in computer science from the National Technological University.

The final computer industry entry for the month comes from **Ed Burke** who is working to bring a new product on line in Bangkok for Data General and is doing "some travelling." Ed says the family has adjusted well to New Hampshire, and that Ann is now in the real estate business in case anyone's interested in moving to the seacoast area.

**Steve Dangel** provides our first robotics news of the month. Steve writes that last summer he started Dangel Robots and Machinery, Inc. to sell arc welding robots and special machinery. He says business is brisk, and that he's working seven days a week doing sales, design and installation. . . . Also in the robot business is **Eric Westerfeld** who writes that his company Adept has grown to a \$32 million dollar company and is the largest U.S. company specializing in assembly robotics.

**Henry Weil** writes that he is senior vice-president and managing director of Pugh-Roberts Associates, Inc., a management consulting firm in Cambridge. PRA now has about 40 employees and plans to open an office in England this year. This year is also PRA's 25th anniversary, and in recognition of the role of M.I.T. in the founding and success of the firm, they've established the Pugh-Roberts Associates, Inc. prizes to be awarded for outstanding papers in the areas of strategic business analysis and management of technology. . . . **Dave Rubin**, a consultant of another sort, is a vice-president of COMSIS Corp., a Baltimore planning consulting firm. Dave's wife Sharon is now dean of the School of Liberal Arts at Salisbury State University and is commuting home on weekends. Son Ari is at the University of Colorado.

**Bruce Golden** writes that he is still practicing corporate law in Chicago with McDermott, Will and Emery and is now chairman of their High Technology and Emerging Industries Group. Bruce recently closed a venture capital financing for a Cambridge-based client. He's also chairman of the M.I.T. Enterprise Forum of Chicago, and gets to see many alumni there. Bruce says his



dance band continues to occupy his weekends. They recently had a job in Elgin (home of **Sandy Morganstern**) and Bruce's sax player had to borrow Sandy's instrument. . . . While we're on the subject of venture capital, **Greg Johnson** left Monsanto and is now a general partner in Gateway Venture Partners, a midwest-based venture capital fund.

**John Kassakian**, the only academic of the month, writes that he's still at M.I.T., teaching and busy doing research in power electronics. John received the IEEE William E. Newell award for "outstanding achievements in power electronics" last June. John also reports that **Ed Foster** is still at Draper Labs, and that **Pete Isard** has moved back to the International Monetary Fund in Washington. . . . **Dave Cook** writes that he was recently named chief of medicine at the Bay Medical Center in Bay City, Mich.

**Pierre Perrolle** reports that after spending Christmas in Washington, he returned to Beijing, China, to begin his second year as counselor for scientific and technological affairs at the U.S. embassy there. Pierre says that U.S.-China cooperation in science and technology is a booming enterprise, and that fellow alumni are especially welcome to contact him when in Beijing. He expects to return to NSF after this foreign service tour. . . . **Martin Thomas** says his family is "alive and well" in Boise, Idaho. They are enjoying the slower pace and uncrowded small-town atmosphere, and he appreciates the work challenge at Ore Ida at the same time.

**Dave Dewan** reports the birth of a son, Robert, on June 5, 1987. The Dewans have a daughter, Leslie, now three years old. . . . At the other end of the family spectrum, **Dave Carrier** writes that daughter Bettina is now attending Wellesley and enjoying Boston, and that Dave and Lilian are reliving many of their own experiences through her. . . . **Joel Westerman** is doing well in the family lace business. Joel and wife Alison have three daughters, Amy, 18, Rachel, 16 and Kate, 3.

**David Cannell**, **Kim Kimerling**, and **David Ernst** have been elected fellows of the American Physical Society. David Cannell is cited for "contributions to our understanding of the low temperature properties of condensed matter systems . . ."; Kim for "fundamental contributions to the measurement and understanding of the electrical properties of defects in semiconductors . . ."; and David Ernst for "development and understanding of intermediate energy reactions, including multiple scattering theory and general structure, and its extension to incorporate the particular features of the pion."

Nice to have enough material for a decent-sized column for a change. Thanks folks.—**Steve Lipner**, Secretary, 6 Midland Rd., Wellesley, MA 02181

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**Stephen S. C. Chung** writes to say that World Scientific Publishing Co. published his book, *MOS Digital Electronics*, last August. . . . **Judith A. Perrolle** is now an associate professor at Northeastern University. She has just published *Computers and Social Change: Information, Property, and Power*. . . . **Nicholas Negroponte** has a new affiliation as director of Rise Technology Inc. in Cambridge. I can't tell whether he also remains director of the M.I.T. Media Lab. (He does.—Ed.)

**Fred Webb** has returned to Bolt Beranek & Newman after a five-year hiatus. He is writing programs for parallel computers, "one of the most exciting areas in computer science today."

As for me, my two girls are doing great things—they learn to read in kindergarten now, and two-year-olds are in a world of their own. My consulting has taken me into BBN recently, where as Fred Webb reports, interesting things happen, the halls are full of Brass Rats, and the rooms are numbered just like the Institute.—**Jeff Kenton**, Secretary, 7 Hill Top Rd., Weston, MA 02193

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**Art Von Waldburg** owns Computer Decisions, a software development and consulting company. He and his wife, Scottie, who flies for United Airlines, have four children, ages 5, 8, 10, and 12. They live in San Geronimo, Calif. . . . **George Sacerdote** has been elected a vice-president at Arthur D. Little, Inc., and will direct the activities of the management analysis section. . . . **John Fittz** is now procurement manager for Korean Nuclear Project. John recently added a two story addition to his home in Granby, Conn., doing most of the work himself.

**David Mechler** remarried in August and became the father of a 5-year-old boy. The Mechlers recently purchased a new house in the country near Oxford, Conn., complete with a front yard pond used for ice skating. David is still working at Emery Air Freight and playing Dixieland trumpet with the Bourbon Street Seven. . . . **Henry Link** writes that he had a great time at our 20th reunion. Henry has worked for the Connecticut Health Department in Hartford for the past nine years and has been a director of the Hartford Ballet for the past four years.

**Chuck Holdaway** and his wife, Marcia, are trying the "ultimate adventure—raising children!" They have a 2-year-old daughter and a 2-month-old son but still find time to perform in a folk, blues, and country music trio. Chuck is director of research and development at JC Systems, Inc., an electronic instrument manufacturer in San Diego. Chuck enjoyed our 20th reunion last summer. "It was the first time I've returned to Cambridge since 1967. As expected, I saw a lot of changes, and yet that same old feeling was still in the air. This institution still seems to have a personality all its own. See you at the next reunion."

**Fred Hottes** is still in Salt Lake City, Utah, specializing in pathology. He writes that with his twins approaching 4, life is returning to "normal."—**James Swanson**, Secretary, 878 Hoffman Terr., Los Altos, CA 94022

## 69

Lots of notes this month from alums near and far. **David L. Lyon** reports from sunny Rancho Santa Fe, Calif., that he has started a new telecommunications company in San Diego, Pacific Communication Sciences, Inc., specializing in digital voice compression and related modulation and coding products. The company began with five people in April 1987 and as of his March 1988 note has 20 people. . . . **Henry E. Haller** reports that in April 1987 he was re-elected to a second term as chairman of the Libertarian Party of Pennsylvania. . . . **Dr. Mark A. Rockoff** was recently promoted to associate professor of anesthesia (pediatrics) at the Harvard Medical School. He still works at Children's Hospital in Boston, doing both anesthesia and critical care medicine. He reports "living happily in Hingham with my wife and three children."

. . . **Dr. Michael E. Solin** writes, "After having graduated from Yale Medical School and completing a residency program in family practice, I have been residing and practicing in Leesburg, Va., with my wife, Enid, and our two children." . . . **Dr. Gary Carpenter** writes, "I moved to the Washington, D.C., area this summer (1987) and am now chief of allergy and clinical immunology at Walter Reed Army Medical Center, director of the U.S. Army Centralized Allergen Extract Lab, and director of the allergy and clinical immunology fellowship program at Walter Reed."

**D. Ross Hunter** writes from Duxbury, Mass., "Catherine and I have a second son, Eric, born in August, 1987. I am involved in a start up company named Ventana Systems. **Laura Peterson** is the president. David Petersen, '68, Karla Karash, '68, Bill Arthur, and Bill Wood, '79, also work at Ventana." . . . **Steven Rothman** was promoted to vice-president of R&D in October at Kurzweil Ap-

plied Intelligence and reports, "I'm working with many M.I.T. graduates: Ray Kurzweil, Aaron Kleiner, Rich Goldhor, Francis Gannon, Joel Feldman, Roy Russell, and several others. Last May I resigned from the local school board (Bolton, Mass.) after five years, two of those as chairman." . . . From across the "drink," **Tom Stewart** writes, "Martha, Michael, and I have moved to Yorkshire, England, for an extended stay. I am currently a consultant, working in communications. My company, Argo Systems, has two such positions. It is quite a change of pace from the Silicon Valley hubbub. We are thoroughly enjoying our life as 'country squires' in a small agricultural village."

**Jeremy K. Raines** of Potomac, Md., says that 1987 "was a record year for Raines Engineering, a small consulting firm specializing in antennas, radio wave propagation, and electromagnetic scattering. We could use some M.I.T. grads as associates. Send resume and fee schedule if interested." . . . **Henry G. Baker, Jr.** writes from Woodland Hills, Calif., "This is my second year of full-time consulting at Synapse Computer Services, providing consulting to venture capitalists and computer companies and I'm enjoying it very much. I'm busier now than as an employee, and making a lot more money to boot."

. . . **Gary Hirsch** in nearby Wayland, Mass., writes, "I continue to work as a management consultant, specializing in hospitals, medical schools, and other health care organizations. My work has recently been taking me far afield to Europe, Pakistan, and east Africa, though I still do quite a bit with institutions in the U.S." Gary's wife, Linda, is a free-lance photojournalist/photographer and their sons Adam (15) and Daniel (10) keep them busy. . . . **Louis S. Metzger** writes, "I haven't moved too far from M.I.T.—currently in Wellesley with my wife Peggy, an attorney, and our son Michael, who will be four in April. I'm seven months into a new job as associate technical director of the Tactical Communications Division of the MITRE Corp. in Bedford, Mass." . . . **Dr. Thomas Najarian** reports, "Sina's concert career is growing. She has been performing with local symphony orchestras and has a tour of part of the Soviet Union in the works. Nova, Marn, and Sina Lucia are well. I continue in the private practice of medicine in our home-office in Belmont, Mass., with an occasional attempt at epidemiological research."

Last, but not least—and certainly the most creative this month—**Bruce Heflinger** from Los Altos Hills, Calif.: "I plan to serve six more years as an ordinary engineer, then begin a 40-year random walk about our green and hospitable planet." Let's hear it for both the ordinary and extraordinary engineers of fine '69!—**Eugene F. Mallove**, Secretary, 183 Woodhill-Hooksett Rd., Bow, NH 03301

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While on leave of absence from Purdue University, where he has been a professor of electrical engineering for 11 years, **Howard Jay Siegel** has joined the Supercomputing Research Center in Lanham, Md. He is doing research on the design and use of large scale parallel processing computer systems. . . . **Dr. Adrian Beham** has been named a fellow of the American Society of Mechanical Engineers. . . . **James G. "Gar" O'Connell** is about to begin a new job working for Nova Biomedical in Waltham, Mass. He is married and has two children, 8-year-old Jonathan and 5-year-old Karen. Last summer **Roger Waldon** and his family stopped by for a visit. Gar's and Roger's wives, Susan and Ann, were friends at Wellesley.

**Mark Snyder** writes: "After teaching physics at various overrated New England Colleges, I switched to computer science in 1986 and am currently research scientist at U.Mass, Amherst studying mathematical approaches to vision. Married, one child (3). Michael Tanner, '70, was killed in New York City April 15, 1984. My son is



named after him." . . . **Jonathan Lukoff** writes: "1987 was an exciting year. I met and married Linda Levy, a native Californian and a practicing speech pathologist. We're redecorating our home in South Laguna, Calif. I'm still practicing pediatrics with the Southern California Permanente Medical Group, better known as 'Kaiser,' the premier HMO. Now a partner, I'm on my ninth year and enjoy the daily challenges it allows me." . . . **William J. Swedish**, his wife, Linda, and their four children traveled to Nepal to visit some good friends. He says it was an enjoyable adventure.

**Robert H. Price** writes: "I left Los Alamos this year after ten years with the University of California to try private enterprise. I am now principal scientist with JAYCOR at the Albuquerque office. Connie and I now have two grand(?) children living in California." . . . **Jaime Olmos** is a simulator engineer for SCE at San Onofre. He obtained his NRC Senior Reactor Operator License last year. He spent his vacation in Cancun with his wife, Vivian, and 5-year-old son, Ariel. . . . A recent article in the *Westfield Evening News* states that the Westfield, Mass., city council turned down the nomination of one of our own, **Walter L. Griffith**, for a three-year term to the Board of Public Works. One of the council men said he felt that Walter was "not qualified" in spite of the fact that Griffith achieved a 4.0 grade point for his doctorate at Harvard and had near perfect grades at M.I.T. I think Abe Lincoln or someone said that one could never go wrong underestimating the intelligence of the American public. That appears to be true for at least one Westfield city councilman.

**Sara "Sally" N. Harvey** writes: "I was recently interviewed for a feature article in *Graduating Engineer's* February 1988 issue on the subject of Networking. (And I don't mean with wires and electrons.) This article focuses on that favorite yuppie occupation, power networking." Sally was the only woman alum brave enough to attend our 15th reunion.

I was recently elected president of the Washington on the Brazos State Park Association, an organization dedicated to the preservation and promotion of the birthplace of Texas liberty and independence. We are embarking on a long-range planning program which will include a possible archaeological investigation of the townsite of the Republic period Washington village.—**R. Hal Moorman**, Secretary, P.O. Box 1808, Brenham, TX 77833-1808

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Hello from sunny Florida! My mail is still sorting its way out in terms of finding me after my move, but I am glad to have news from a number of you. **Anne Marie** and **John Scalea** are still in Great Falls, Va., where John works for U.S. Air and both continue to sing with the St. Thomas a Becket Contemporary Choir, which John directs. The family took a trip to the Smokies, and to Boston last summer, but missed the reunion. Son Mike is in fourth grade, Joe in second, and sons David, 4, and Richard, 2, are not yet in school full time. The whole family looks great!

**Becky Donnellan** is still working at the Justice Department. She has been doing less traveling with work, since she has two children. However, she has taken them both out to Los Angeles for one business trip and is having a lot of fun with them.

**Josie Pian** and **Douglas Breeden** now have four children ages 1, 5, 7, and 10. Doug also notes that he is an associate professor of finance at the Fuqua School of Business at Duke. He is also chairman of the board of Smith Breeden Associates, Inc. a consulting firm that hedges interest rate risks for 25 billion of savings and loan assets. He enclosed an interesting copy of a nine-page interview in *Intermarket* magazine, and *Forbes* was scheduled to do one in early 1988. Doug forgot additional news of Josie, but one can assume she is busy.

**Paul Hendrickson** is continuing his management consulting practice for financial services institutions and their technology providers. He is also kept busy by his two children, Greg, 7, and Cherie, 2.

**Sarah "Sally" Simon** is still having a great time as deputy director of the Massachusetts Air Quality program. They are establishing some standards and procedures for measuring toxic air pollutants in the air we breathe (so when we go back for our next reunion it can be good for us as well as fun). She is trying to invest in enough modern computer equipment to prepare for the '90s—no small task! Due to that, she is cutting back on engineering society activities, planning only one seminar for the civils last January, which was on controlling toxics. She looks forward to seeing friends at the AMITA-SWE Conference.

**Paul Levy**, as executive director of the Massachusetts Water Resources Authority, heads the Boston Harbor cleanup program.

**James A. McAtamney** has been reassigned to the International Affairs Division, Office of the Judge Advocate General at the Pentagon, after three years of teaching in the Judge Advocate General's School in Charlottesville, Va. He is enjoying the real practice, more than the theory of teaching, even though he did enjoy teaching. Big news of the year was his marriage to Ellen Arog. They both graduated from William & Mary Law in 1976. They remain busy rebuilding their humble abode in Falls Church. . . . **Larry Prier** has been made assistant vice-president of claims management at Union Pacific Railroad, a new position. . . . **Richard R. Eckert**, chief resident at the Queen's Medical Center in Honolulu, has received the Norman T. Kirk Award from the Society of Military Orthopaedic Surgeons. He is also a major in the U.S. Air Force. . . . **Nathaniel Fisch** has been cited as a newly-elected fellow of the American Physical Society.

That's it for this month's news. It continues to be great down here in the sun as I write this on a sunny April day. I imagine it will be hot by the time that you read it in July, but I expect at that point to be summering on the Riviera and other parts of France. In the meantime, please continue to send your notes to my new residence in Florida, or to our co-secretary, **Dick Fletcher—Wendy Elaine Erb**, 6001 Pelican Bay Blvd., Apt. 1003, Naples, FL 33963

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Embarrassment of riches time! I would save some of the letters to enhance the next column, but I already got one note from somebody with a copy of a letter he had sent, asking why it hadn't already appeared in the Notes. It takes, if you're interested, about 4-6 months from the time you send it, so hang in there.

**David Porush** writes a letter with hefty gratitude for the column (you're welcome). He's at RPI ("a slightly diminished version of M.I.T.") teaching literature and interdisciplinary studies. Married, with daughters Valerie, Dana and newborn Benjamin, David has just published a book *The Soft Machine: Cybernetic Fiction*, combining his interest in literature with that of theoretical science. It has been translated already into several languages. Now he is starting work on a play ("sort of 'Marx Brothers meet Star Wars'"). . . . **Roger Lace** is a partner in an investment counseling firm in Toronto, where he lives with his wife and two boys, Joseph and George.

**Robert Miegel** is practicing orthopedic surgery at Harvard Medical School and is chief of orthopedic surgery at Harvard Community Health Plan. . . . **Eric Suuberg** married Ina Vatvars this past April, with whom he lives in Providence. Eric is teaching engineering at Brown University as an associate professor. . . . **Stuart Traver** lives outside Houston, working for Conoco as an exploration lease negotiator in foreign countries. Stu and wife have three little ones now (children, not

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foreign countries). . . . **Carl Rosenberg** writes in  
verse, and even TR's editors wouldn't dare cut a  
line, so here 'tis:

"Valiantly I faced the world  
An HMO for me  
No more an academic I  
Begging for each penny;  
But soon I found that there's a price  
For every choice we make  
And being just a timelock doc  
Was just too much to take;  
So I ran from sunny lands  
From spending, flash and glitz  
To land an academic post  
In cold Worcester, Massachusetts"

**Steve Richardson** writes more prosaically that  
after 11 years at HP, he has gone to work for  
Compression Labs, Inc., manufacturing two-way  
video tele-conferencing equipment. . . . **John  
Chandler** is still with the Smithsonian at the As-  
trophysical Observatory in Cambridge, testing  
gravitational theory. John will be involved with  
the joint Soviet/French (and American) un-  
manned expedition to Mars' moon Phobos.

Jan and **Tom Stagliano** are back in the Boston  
area. Tom is still with Kaman ArDyne, now as  
associate head of structures. He's still active  
refereeing soccer (including the New England  
College Women's All-Star Game) and playing  
hockey.

**Cynthia Stratton** and husband Martin O'Malley  
had their third son last May. She is working part  
time as an attorney, amazed that their time in  
Houston has stretched to 12 years. . . . **David  
Moylan** obtained his private pilot's license in  
November 1986. A month later second child Tara  
was born, so wife Denise is taking some time off  
(she's also a physician) to spend with the wee  
ones.

**Douglas Mink** moved up the river to the

Harvard-Smithsonian Center for Astrophysics in  
1984 after six years on the research staff at M.I.T.  
The last three have been spent reducing data  
from one of the shuttle telescopes. Currently  
president of the Boston Area Bicycle Coalition,  
Doug commutes twenty miles a day all year to  
work. . . . In 1968, before M.I.T. was alma mater,  
yours truly was on a bowling team in Chicago  
with **Daniel Klein**; he's now writing for the first  
time since graduation and proud to announce the  
birth of second son Ethan, joining Matthew. . . .  
and **Cherry Murray** received a fellowship (from  
an unspecified source—sorry!) with a citation "for  
studies of the surface-enhanced Raman effect and  
of two-dimensional melting."

Back to bowling, yours again has reached one  
of those personal goals (if I can hold it) with a  
190 average through March, with seven weeks left  
in the league season. Stay tuned. Yesterday both  
boys brought home sterling report cards; Eric and  
Jr. are headed back to the public schools this fall,  
and their good work should serve them well.  
Ruth is fine and busy redoing the house again.—  
**Robert M. O. Sutton, Sr.**, Secretary, "Chapel  
Hill," 1302 Churchill Ct., Marshall, VA 22115

## 74

The torrent of mail that hit my desk was greater  
than I've ever seen. Almost all the notes were on  
those Alumni Fund gift reply slips. Thank you all  
for your generosity. Also, I'm making a new  
resolve: personal letters get personal replies. So,  
with the strains of "In-a-Gadda-Da-Vida" on the  
tape deck, let's get to this mid-summer column.

**Paul Mailman** posts his remarks from Box-  
borough, Mass. "After six years, I'm still with  
Atex. In November I become manager of the  
Training Technologies group. I do a little of every-  
thing: teaching, writing, programming, manag-  
ing." Paul also notes that he joined the ranks of  
the "formerly married" in 1986. "I irregularly play  
phone tag with **Guy Consolmagno**, who is cur-  
rently teaching college physics in Pennsylvania af-  
ter a two-year Peace Corps stint in Kenya." Guy!  
Write Paul! You're never home! Paul also keeps in  
touch with **Mike Timmreck**, Gaytha and **Charlie  
Hillman**, Cherie and **Dave Shepard**, and **Amos  
Oshrin**. Thanks for the news.

**Tetsuto Numata** is now a full-time orthopedic  
surgeon specializing in joint replacement and  
sports injuries. . . . In more medical news, **Jeffrey  
Weinreb** has moved to the Big Apple to become  
director of magnetic resonance imaging and as-  
sociate professor of radiology at the New York  
University School of Medicine. His first book,  
*Body MRI*, was published in 1987. . . . And finally  
on the medical front, **Jerry Kramer** is in private  
practice these days in Stuart, Fla., doing derma-  
tology and dermatologic surgery.

Assistant director of statistics at Pfizer, **Marcia  
(Levenstein) Weisman** writes that she has two  
children, Rachel and David. . . . Cynthia and  
**Ken Skier** had a son, Benjamin, a year ago.  
Daughter Stephanie is five. Ken is the author of  
BYLINE, Ashton-Tate's new desktop-publishing  
program for PCs. Ken has finally come up for air  
after working on the product for two years. . . .  
**Dave Withee** has recently been promoted to retail  
sales manager. He's taking MBA classes. "Its fun  
comparing book and class learning to real-life ex-  
periences," says Dave. . . . **Paul Moroney** writes:  
"Married in 1980 to Jean Erickson. Two children,  
Elizabeth and David. Currently at General Instru-  
ment Video Cipher Division, San Diego."

Former HELL's Angel **Tom Wolff**, his wife, Mar-  
cy, and their daughter, Ilana, are readying their  
house (spiritually and literally) for the arrival of  
their second child in May. Says Tom, "It's hard to  
imagine we can become any happier or busier,  
but. . . ."

**Fujio Hayashi** is now working for Mead Imag-  
ing, a division of Mead Corp., as director of  
Product Planning. . . . **Wayne Stargardt** is now  
director, Network Systems, at the Harris Corp.  
Data Communications Division in Dallas. "Life is

culturally rich, Dallas is very enjoyable, although  
I miss the frequent sailing in Florida." . . . **Stan-  
ley Young** is working with Warren Levy at  
Unigene. Unigene "went public" a year ago. Stan-  
ley loves Cape Cod though Denville, N.J. is his  
home. . . . **Charlie Bruno** writes, "The oil price  
crash ended the best job I have had. Floundering  
in dead-end job working for federal government.  
Searching diligently to secure a better job."

Susan and **Dennis Dickstein** have a son, Jona-  
than Michael, now two. Dennis is a vice-  
president at Salomon Brothers, responsible for  
budgeting, consolidated reporting, and expense  
management. . . . A note from **Allen Williams**  
reports: "I'm currently a senior engineer in a gal-  
lium arsenide I.C. wafer development line at  
AT&T Microelectronics in Reading, Pa., . . .  
"Work continues at Lincoln with recent diversions  
into room temperature superconductivity," writes  
**Ted Kochanski**. "We moved last June to our sec-  
ond Lexington house. This will be more of a  
project than the last one, but when we finish we  
expect to give Bob Villa a run for the ratings."

Iron Butterfly is long done with their song now.  
Your ever-faithful class secretary is organizing the  
centennial reunion celebration for Phi Gamma  
Delta at M.I.T. to take place in April '89, growing  
vegetables in the front yard (the only place it's  
sunny!), and deeply enjoying married life. Please  
write.—**Lionel Goulet**, 115 Albemarle Rd.,  
Waltham, MA 02154-8133

## 75

We have quite a bit of news this month. Thanks  
to all of you who wrote in. **Joel H. Kulp** is work-  
ing for Motorola in Fort Worth, Texas. He also  
received an M.B.A. degree from the University of  
Dallas in December 1987. . . . **Lew Weinstein**  
writes, "I am currently a vice-president with  
Mitchell, Larsen & Ziliacus, an executive search  
firm in Los Angeles. My primary focus has been  
finding senior executives for financial services  
and high tech companies, but we have a broad  
practice covering all industries and most function-  
al areas. I am married (to a Harvard Business  
School classmate) and live in Manhattan Beach,  
and am always glad to hear from fellow alumni  
(work phone is 213-489-7120). . . . **Michael Gipe**  
is now entering his fifth year running Blue Sky  
Engineering Co., a consulting firm. . . . **John  
Eidinger** now manages the Advanced Engineering  
Division of Impell in San Francisco. It's ten years  
now and John believes he is the only graduate of  
Alpha Epsilon Pi, '75, who is still an engineer  
(the rumor is that all his frat brothers are wildly  
successful medical doctors). If he is wrong, he  
wants to know from his classmates. So drop him  
a line, c/o Impell, 350 Lennon Lane, Walnut  
Creek, CA 94598.

**Matthew Scott** is an associate professor at the  
Department of Molecular, Cellular and Develop-  
mental Biology at the University of Colorado at  
Boulder. . . . Writes **Richard Withers**, "The world  
of superconductive electronics, in which our  
group at Lincoln Labs has been involved for  
several years, has suddenly become much more  
exciting." He also adds, "It's nice to be single  
again, but the judicial system for this is in sore  
need of reform."

This brings me to our class of '75 legal corner  
in which **Kenneth Rubenstein**, along with  
Charles Guttman, '69, has established the law  
firm of Marmorek, Guttman & Rubenstein in  
New York City. His law firm specializes in patent,  
licensing and other intellectual property matters  
and is especially strong in high tech fields. Ken  
resides in West Orange, N.J., and he and his wife  
Randee had a new baby daughter last September,  
Sara, sister to Ari. . . . **Brian G. Lustbader**  
writes, "In 1986, I left the New York law firm of  
Rosenmann & Colin to become a partner in a law  
firm that specializes in real estate development  
and construction law and litigation: M. Carl Le-  
vine, Morgulas & Foreman. More recently on  
November 21, 1986, Rachel and I had our second



child, Ilana Anne. We now have two wonderful girls (our first, Sarah Pazit was five in January)."

More news from classmates with kids: **Alan H. Katz** and wife Pam became parents of Jordan Rebekah on September 18, 1987. . . . **Kenneth S. Rumstay** had a second daughter, Rachel, born on July 18, 1987. Ken also writes, "The Valdosta State College Astronomy and Physics Department (in which I am an assistant professor) is about to join an international consortium to do VLBI (Very Long Baseline Interferometry). . . . **Peter J. Mancuso** writes: "My daughter, Catherine Elizabeth Mancuso, was born on June 15, 1987. Her brother Stephen is two years old. I was elected president of the Long Island M.I.T. Alumni Club last spring and have devoted a considerable amount of time to its activities." . . . **Ron Bick** and wife, Danielle, live with their two children in Framingham, Mass. Rob is a radiologist at Worcester Memorial Hospital, and Danielle is a psychiatrist at University Hospital in Boston. They are well and happy and would enjoy hearing from old friends. Asks Ron, "Anybody have any ideas on how to de-regulate Massachusetts medicine?"

I received a copy of, and enjoyed reading, an article co-authored by Edwin Diamond and **Norman Sandler** appearing in the Winter 1988 issue (Vol. IV, No. 2) of *Issues in Science and Technology*, entitled "Panning for Issues in Campaign '88".

I'll end this column with a cheery note from **Jim Demers** who writes, "Greetings to any MacGregor Turkeys out there reading *Tech Review*. Still living in Manhattan and would be happy to entertain visitors from H entry's glorious past (I'm in the book)."

That's all folks. Keep writing.—**Jennifer Gordon**, Secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036; or 18 Montgomery Pl., Brooklyn, NY 11215

## 76

The mails have provide us with a mixture of news. I am deeply sorry to report the death of Donna Struth, wife of classmate **Bob Struth**, on February 28. John is a navy test pilot on the F-14D program with a 2-year-old son. Our sympathies go out to Bob.

**Jim Banks** is "currently living in San Jose, Calif., with my wife and 1-year-old daughter. Working as an engineering manager with Hewlett-Packard in Cupertino, Calif. Visit M.I.T. at least twice a year to coordinate H-P recruiting activities on campus." . . . **Mike Royal** is "graduating from University of Maryland School of Law and will be moving to Pittsburgh to join the law firm of Eckert Seamans to practice health care law in May 1988. Presently doing internal medicine residence at Ft. Meade, Md., finishing up an army obligation." . . . **Lee Silberman** has had a busy year. "Our son Russell is growing like a weed and fortunately has his mother's disposition. I am in the process of installing a new computer for my business to prove the saying it is who you know and not what you know. I gave the contract to a company represented by Mark Hellinger, '80, in return for his pledge to make a substantial contribution to the Alumni Fund upon signing the contracts. As conversion headaches seem to be putting me out of business, I think M.I.T. got the better of the deal."

**Jeff Jaffe** was "recently elected as a fellow of the IEEE. Currently managing communications research at IBM T. J. Watson Research Center." . . . **Martin Brock** is "enjoying my mathematics and my tennis. I love the City University of New York Mathematics Department very much. I'm doing my research in commutative algebra and applications, especially multivariate polynomial ideal theory. Also, I'm working part-time for a professor there, and we're doing/developing some of the modern mathematics of X-ray crystallography. Hello to: **Geoff Garner**, **Roy DeMeo**, and **Richard Stone**!". . . . **Robert Chen** has "completed my doctorate at the University of North Carolina at Chapel Hill and am now an associate professor

with the Alan Shawn Feinstein World Hunger Program at Brown University. I'm also happy to announce the birth of my son, Bryce Golden Chen." . . . **James Wajda** is "still at IBM, now working on the large system processor performance analysis area." . . . **Peter Kaufman**, M.D., is "currently an assistant professor of medicine (gastroenterology) at Bowman Gray School of Medicine in Winston-Salem, N.C. My current research includes small intestine and colonic motility."

**Michael Jung**, '75, and **Gretchen Megowen** "have a new arrival at home, Margaret Megowen, future M.I.T. '09. Meanwhile, Mike has been elected president of the Dallas Homeowners League and has been appointed to the Dallas City Planning and Zoning Commission." . . . **Melissa Weiksnar** writes: "Philip is now 3 and Evelyn 2. They are most delightful, though I still rarely get to sleep through the night. (One of those things about parenthood that's hard to believe 'til one encounters it.) If Philip's prowess with Legos is a leading indicator, Course II had better watch out. I was recently promoted to section manager at Apollo." . . . **Olimpio A. DeMarco** has "forsaken the condo life for a more child-conducive home in Andover, Mass. Daughter Stephanie (2) loves the swing set and swimming pool, while pregnant mother Jennifer loves thinking of house projects for Daddy to do in his 'spare' time. Meanwhile, I am in my fifth year of employment with Computervision, my 11th year of part-time M.B.A. courses, and my first year as general manager of a paper 'NBA' (Nameless Basketball Association) team. The latter activity is especially enjoyable since it combines my love of sports with my mathematical/statistical bent and my competitive nature. Would like to hear from some of the NRSA gang, circa 1974-78."

**Rick McAdoo** writes: "I like to think I am a representative M.I.T. alumnus: modestly successful professionally and happy enough personally. In contrast to many of *Tech Review's* correspondents, I have not married anyone from any class of any university, have no children, have not published any books or papers, am not a partner in a law firm or head of research for a corporation, do not own my own business, have not renovated a quaint farmhouse, am not a physician, am not running for office, and am not involved with the homeless, the Central America sanctuary movement, or any church. I work hard and hope the Cleveland Indians might someday win the pennant." (Secretary's note: I keep praying for the Red Sox.)

From **Barry Goldman**: "My son was born in February. He is growing rapidly, and his first Harvard stretchie is already too small. Last May, I switched jobs, leaving consulting with Touche Ross and moving to Goldman, Sachs and Co. (my name is already on the letterhead—too bad there's no relation), where I am a manager in the Operations Division. The job is just across the Hudson from where I used to work, and I am still living in the same location. I now commute to work via a new ferry service that goes from Weehawken, N.J. to Wall St. The new job is going well, and I've gotten involved in a lot of interesting things. I help coordinate the Operation Division's activities in preparing for the introduction of new firm products and am also implementing a firm-wide management reporting system on Operation's performance." . . . **Gail Rubin Walker** has "had our first child, a daughter Rebecca Lillian, on February 27, 1988. She is a wonderful baby. I'm home with her on maternity leave until mid-May, when I'll return to my job as RS/1 development manager at BBN Software Products Corp. RS/1 is a scientific package used in scientific engineering and manufacturing applications. I've been at BBN since July 1976."

**Neil Leiblich** is now the chairman of the Department of Pediatrics of Benedictine Hospital in Kingston, N.Y., where he is enjoying life very much. . . . **Michael Lynch** has had an article on the future prospects for crude oil published in *Technology Review* (November/December 1987,

p.38). It has begun attracting critical notice, as it hypothesizes a lower likelihood of a future OPEC price shock. Your secretary, an avid trader of crude and product futures, read it with interest. . . . **Dan Dershowitz** and **Debbi Gross** have a daughter. Dan and I had a very pleasant chat on the phone about the news.

As for your secretary, he still has a great fondness for bear markets, as prices always fall faster than they rise. In addition, it is good for business as it brings me hedging clients in a variety of areas, as well as stimulates activity from clients who are already on the books of my firm. Paradoxically, I benefit the most in times of much uncertainty and stress in the financial markets. My major concern is that everything should cool off and be calm. However, as I write these notes in April, this has not been the case in a fair number of markets I deal in. On the family side, my daughter continues to grow at a rate I find astonishing. Where has all the time gone? I do not feel older, but time has clearly passed. I think brokering and trading futures may have damaged or destroyed my perspective on the passage of time. After all, futures are, in New York and elsewhere, "the fastest game in town." Please write. We sorely need the news.—**Arthur J. Carp**, Secretary, Stalco Futures, Inc., 254 West 35th St., 16th Floor, New York, NY 10001, (212) 736-1960

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All, count 'em, all of this month's tidbits are excerpted from either press releases or those cards attached to your M.I.T. contribution forms. Remember, your personal notes, musings, memoirs, etc., are always welcome at my address.

We begin with the news that **Michael J. Cady**, formerly senior project manager, has been promoted to vice-president, New England Division of the Manganaro Corp. in Malden, Mass. . . . Also taking a step up the corporate ladder is **Greg Resker**, newly named executive vice-president at Curtis Manufacturing Co., Inc., of Peterborough (N.H., presumably). He was a co-founder of Curtis in 1982.

**Karen Kaufman** reports from San Diego that she is still at General Dynamics. She has recently joined Toastmasters International, has taken up playing piano, and has joined a singing group. . . . **Jeff Babb** has moved to Los Angeles and has a new baby girl, Elizabeth Anne. He wants us all to know that "All is here, wish you were fine."

**David Doo** in Anaheim, Calif., is competing with his one-and-a-half-year-old daughter, Joanne (Jo-Jo), for computer time. He writes that she loves to bang away on his PC and she exchanges letters with Erin Tao (daughter of Bernie Tao '76) via word processors. . . . **Richard Baer** lives in Los Altos, Calif., with his wife, Janis, and two-year-old daughter, Jennifer, where they all enjoy swimming outdoors year 'round, cycling, and hiking. Last summer he was promoted to project manager in the Photonics Department of Hewlett-Packard's Research Laboratory in Los Altos.

**Elliot Lach**, having completed a plastic-surgery fellowship at Brigham & Women's/Children's Hospital in Boston, is now on full-time staff of the Surgery Department at UMass Medical Center in Worcester. Elliot lives in Framingham, Mass., and invites alumni in the area to call or drop by. . . . **Daniel Higgins** is practicing general surgery at the Palm Beach Medical Group in Florida. He went to medical school at the University of Pennsylvania and did his residency at Graduate Hospital in Philadelphia. He is married to Mary Jo Basara.

On the other side of the scalpel will be yours truly next month as I become a mother for the third time. If everything goes as planned, we'll be welcoming a new little Maragioglio Hertz baby on 8/8/88 at 8:08 a.m. I'll keep you all informed—why don't you all return the favor? Let me know what's up with you!—**Ninamarie Maragioglio**, Secretary, 8459 Yellow Leaf Court, Springfield, VA 22153



I recently heard it said that babies are the Cuisinarts of the 1980s—everybody's having one. So it seems. This month alone, I count 19 notes about new kids. And the 1980s still have a year and a half to go! So with no further ado, here are our latest class baby announcements, in alphabetical order.

Class Treasurer and Reunion Chair **Karyn Altman-Velazquez** took time out from planning our reunion to give birth to son Jason Gregory on February 3. Karyn has gone back to work as M.I.T.'s volleyball coach, and she's already teaching Jason how to spike.

**Mimi (Montgomery) Blake** sends her regrets for having to miss our 10th reunion, but her third child is due on May 16. She adds that she is "very disappointed about not rowing in an alumnae boat at the reunion."

My old roommate Tom "Touchdown" Davidson, '77, called me to glowingly announce that his wife, **Pat Brown**, gave birth to their first child, Emily Catherine, on March 31. (Pat will take a year off from her job in environmental engineering, while Tom brings home the bacon as a mechanical engineering consultant.) . . . Nancy and **Donald Choing's** daughter, Allison, was born on their first wedding anniversary. (Some guys'll do anything to avoid taking their wife out for an anniversary dinner.) Donald is working for IBM Sales in New Jersey.

**Gerry Epstein's** wife had a baby, Alana Doralyn, last July 3. He's still at the Office of Technology Assessment, preparing reports on issues such as fusion energy and the Strategic Defense Initiative (Star Wars). . . . **Chris (Hind) Genly** wrote to tell us about her daughter Kimberly, age two and a half. . . . When we spoke, **Larry Gordon's** daughter, Beth, was expecting company—his wife, Carolea, was due to have another baby in April. Larry has his own medical practice just north of Princeton, N.J.

My fraternity sister **Ellen Katz** and fraternity brother **Jay Werb** had their second child, Christopher Joseph, in March. Their daughter, Julia, is four. . . . According to the grapevine, **Sharon (Pastoriza)** and **Doug King** recently had their second son. Details after reunion. . . . **Roby (Rosen)** and **John Marcou** are still living in Anchorage, Alaska, with Kevin (age three) and their new son, David (almost one). Roby is primarily doing evaluations of youngsters with learning disabilities, as well as some general pediatrics, while John works as an engineer for ARCO Alaska. Roby writes: "We're enjoying a legitimate Alaskan winter—complete with the occasional moose in the front yard."

I got a note from **Stephen Perry** announcing that he and his wife, Darlene, are the proud parents of two-year-old Lisa. Steve graduated from Harvard Law School and has been practicing at Casner, Edwards and Roseman in Boston since 1981. . . . **Carol (Pokodner) Power** sent me a postcard to announce the birth of her second child, Benjamin Jeremy, on March 10. Carol has retired from the corporate world for a while to stay home with the kids. In her spare spare time, Carol does some consulting and/or computer work. . . . **Scott Prey** and **Marianne Unger** wrote about their three-year-old son, Adam. Marianne is finishing her training as a pathologist in St. Louis. . . . **Norman Sheppard** wrote to announce the birth of his second child, Peter. Peter's older sister is now three.

**Sandi (Haber) Sweeney's** son, Brian, is now about two years old. Sandi is in trading on Wall Street; I caught her back around Thanksgiving, and (no surprise) she was utterly exhausted after those four days of record trading. . . . **Nancy (Greenberg) Taylor** sent me a birthday-party invitation to announce the birth of her third daughter, Claire (November 17). (Katie is seven and Jennifer is four.) Nancy works as a senior research engineer at Amoco near Chicago.

**Tom Van Laan's** note announced that his wife,

Ruth Dreesen, was expecting a baby in April. Tom recently published a book called *Piping and Pipe Support Systems Design and Engineering* (McGraw-Hill). . . . I ran into **Marianna Vertenstein** and **Steve Goldhaber**, '79, on the Green Line, on the very day that Marianna was due to give birth; Tanya Sofia was born a couple of days later. Marianna's other big news is that she "phinished" her Ph.D. in chemical physics at Harvard and went to work at Bolt, Beranek and Newman in Cambridge, doing—you guessed it—computer work. Steve, another physics Ph.D., is also doing computer work—for Thinking Machines Corp. in Cambridge.

And finally, I'm happy to pass on **Italo Visco's** announcement that he is the proud parent of a new baby boy born in May 1987.

Whew! Any more kids will have to wait for the next secretary. . . . Now to people who didn't write about their kids.

Everyone in my old fraternity (PiKa) always knew that **Jon Seiber** would make his mark some day, but we certainly never thought it would be through his penmanship. However, as reported by AP, Jon met happy fate when he created a computerized calligraphy system to address the invitations to his brother Joe's wedding. Jon and Joe soon began to market the system as iScribe—a system that in 10 minutes can turn out lettering that would take a calligrapher 10 hours. (An ironic note: the system's lettering was too perfect for some customers, so Jon went back and programmed in glitches and imperfections to make it look hand-drawn.) They've now sold systems to all kinds of organizations—including one to the White House, one of their first customers.

More computer-ish news. . . . **Ely Dahan** recently celebrated his fifth anniversary managing the Entre Computer Center of Baltimore. He writes: "Also brought in the new year with a wild party at our home, severely testing the structural integrity of the house I designed." . . . After five years with DEC, **Greg Thompson** got involved in the start-up of Interlink Computer Sciences in 1982. Six and a half years later, the Fremont, Calif., company (which builds "gateways" between DEC and IBM systems) brings in \$13 million. Greg got married around Christmas.

**Julie Kozaczka** wrote to announce both her successful career change to computer science and her upcoming marriage. Julie works at Mass. General Hospital, teaching Harvard Medical School students, faculty, and staff how to overcome computer phobia. "My favorite part of the job is being the administrator of an electronic mail system—which forces the 600-plus users to spell 'Kozaczka' on-line at least once." She's now threatening to hyphenate Kozaczka with her fiancé's name (Rick Stahlhut, another career changer—from medicine to computers), which is sending tremors of fear throughout the Massachusetts medical community.

Speaking of the medical community. . . . **Lann Salyard** will have finished his psychiatry residency at the Medical College of Pennsylvania in June, and from there will go into private psychiatric practice in the Philadelphia area. . . . **Steve Stein** has now become board certified in emergency medicine. He practices in Rutland, Vt., which gives him a great opportunity to get in some skiing at Pico and Killington.

It seems that **Jane Butler** was on her way to Baden-Baden, West Germany (where she was to teach American aerobics), when she got into a horseback-riding accident in Hungary. (Why didn't she just take an airplane? While there she designed a program that helped her recover astonishingly quickly. So she was invited to stay and teach that program to others. Now living in Hungary ("I adore it here"), she teaches aerobics and studies Hungarian water therapy.

Having completed her post-doc, **Sue Copper-smith** got contact lenses, a perm, and a new job (Bell Labs in N.J.). She reports being alive and well and living in a converted warehouse in the West Village in New York City with husband Rob Blank. . . . **Josie Stein** got a fellowship from the

American Association for the Advancement of Science to do research work in D.C. for Rep. George Brown of Riverside, Calif. (according to Josie, one of the few member of Congress with a physics degree).

**Bob Marcialis** is working on his Ph.D. in planetary sciences at the University of Arizona in Tucson, studying satellites of Uranus, Neptune, and Pluto. During off-hours he umpires for the NCAA, and has reached the regional level of post-season play with the Amateur Softball Association. . . . **George Aronson** recently married Janet Krasner at a "wild wedding in N.J." He's now working at CSI Resource Systems, a small engineering consulting firm in Boston specializing in waste-to-energy and garbage. In his spare time he plays guitar and bridge. . . . A note from **Andy Stern** to announce that he has been elected to partnership in Booz, Allen & Hamilton in Chicago, where he heads the firm's strategy practice.

**Allan Mink** has just been promoted to Air Force major—about two years ahead of schedule. Along with the promotion comes a new posting to Loring Air Force Base in Maine. Also in uniform is **Drahomir "Mike" Lazar**, who is program officer for the Advanced Medium Range Air-to-Air Missile test program at the Pacific Missile Test Center, Pt. Mugu, Calif.

"A short retirement gave me a chance to devote some philanthropic time and energy to the Berkeley Shakespeare Festival," writes **Brad Alborn** from Vallejo, Calif. "I was enticed back into the work force by a recent start-up, West Coast Information Systems. Looks like I'll be playing with some neat computers again and traveling around the country." . . . **Naomi (Johnson) Miller** is now a principal at Luminae, a lighting design firm in San Francisco. She and her partner did the lighting renovation of St. Mary's Cathedral in preparation for the Pope's visit last September. . . . A note from **Ken Li**, who is living in Piedmont, Calif. "Since last June, I've been working for Varian Associates, designing new products for gas chromatography. I'm finding the environment at work to be a refreshing change."

**Al Knauf** has opened his own law practice in his hometown of Pittsford, N.Y. (near Rochester), doing environmental law as well as general practice. . . . Another old roommate, **Bob McLay**, has finally settled down: "By the time you read this, I will have my Ph.D. in engineering mechanics from the University of Texas at Austin. I got married in May '86 to Cheryl Coldwater, a pediatrician. Life is pretty good to me in Texas." . . . Also finishing up his graduate study is **Erik Brisson**. Erik and his wife, Eileen Sullivan, live in Seattle, where he is a graduate student in computer science at the University of Washington.

Last and least there's little old me. Not much has changed since our last installment. We tried to buy a townhouse in Cambridge, but failed.—**David S. Brown**, Secretary, 50 Follen St., #104, Cambridge, MA 02138

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**Patricia (Tayntor) Strat** wrote me a note on a charming piece of M.I.T. stationery to let me know that she and husband Tom Strat, '77, had their first child, Andrew, on January 30. Patricia was in the navy until 1983 and since then has been working at SRI International, recently receiving a promotion to senior business manager in the Physical Sciences Division. She received her M.B.A. from San Jose State University in May 1987 after three years of night school. The Strats make their home in Redwood City (how picturesque!). . . . Also out of the navy (and in California) is **Ben Cooper**, who left the navy's Nuclear Power Program in 1985 to pursue an M.B.A. at UC/Berkeley. He is now in graphics product marketing at Intel Corp., and living in Santa Clara.

Still more news from California. . . . **Daniel Larner** got his master's in computer science from



Stanford last December, with a specialty in symbolic and heuristic programming. He lives in Mountain View (also picturesque!). . . . **Joyce Thompson** just finished a year of teaching semiconductor physics and device physics to graduate students at King Mongkut's Institute of Technology, Ladkrabang, in Bangkok, Thailand. She was at press time preparing to return to Palo Alto to work for Watkins-Johnson Co.

And now for the New England contingent. **Bonnie Mason** writes, "Al and I are still suffering through New Hampshire winters. I'm still at Wang Labs. My current position is principal systems engineer, which really means I'm a jack-of-all-trades trying to provide technical support on Wang's contract with the air force. Al (Chock '78) is doing well in spite of his long commute every day to his job at Altran, a Boston engineering consulting firm. So far, no kids, but three birds and a rabbit!" . . . **Steven Bauer** writes, "1987 has been a busy year. First, I bought an 1850s town house on Beacon Hill with an unforgettable address: 69 Joy St. I was married in September to Sarah Moynihan, Wellesley '83. I am specializing in high-tech patent and litigation law, am teaching patent law at Boston University Law School, and have been named by the American Arbitration Association to their panel of arbitrators for high-tech matters."

Moving along the Atlantic Coast . . . **Michael Kan**, formerly assistant town manager of West Hartford, Conn., has been named acting finance director. . . . **Gail Kaiser** writes, "I am in my third year on the computer science faculty at Columbia University. I'm now supervising eight Ph.D. students, who are driving me crazy. And I'm drowning in work. But I love it!" . . . **Pamela Berry** is practicing federal tax law at Steptoe and Johnson in Washington, D.C. . . . **Margie and Jim Lester** moved from D.C. to Greensboro, North Carolina last September. He writes, "I am continuing my practice of construction law, representing contractors and owners in disputes arising out of large projects. I saw **Greg George** in St. Louis. He is engaged to be married in the spring of '88 and will start his eye surgery practice in the Bakersfield, Calif., area in the summer."

This has been a particularly busy time for your faithful secretary as well. Tonight I open in a production of the musical revue "Jerry's Girls" with my community theatre group ("Off-Off-Broadway" is how the newspapers list us). I am also making an appearance in two weeks in a revue at Rockefeller University (where my husband works), aptly titled *The Rockefollies*. In addition, things are really hectic at work, plus I had the bad timing to move to a new apartment two weeks ago, so note the new address.—**Sharon Lowenheim**, Secretary, 500 E. 63rd St., Apt. 18B, New York, NY 10021

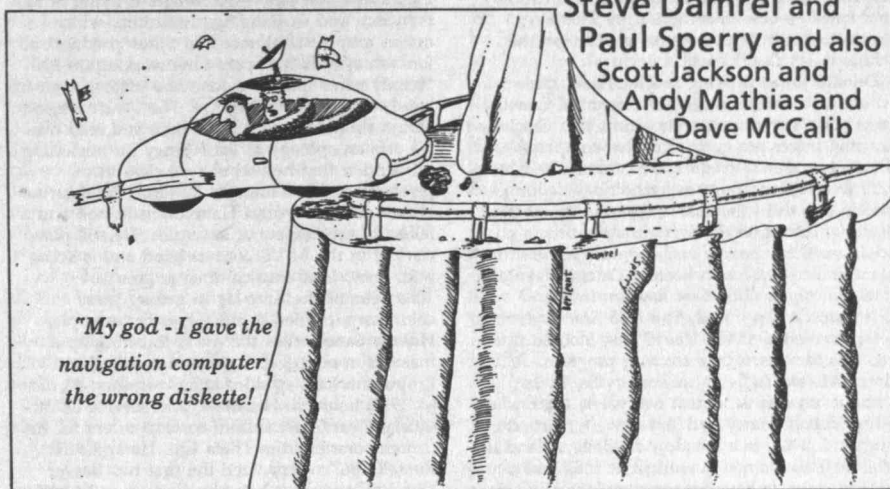
## 80

Greetings and Happy July 4 from Cambridge! Let's start this month off with a live one. **Tom Zibro** writes: "Hi, alive, well, and married? Doing consulting work in Nashua, N.H. Hawkeye stopped by last spring—it was good to see him again. Augie, Skeeter, Dez, and Ratack doing fine. Curious about the whereabouts of Mr. Ric, Maino Dan, Fen, Rocky, Snort, RALPH!, The Rat-zelizer, Ah So, and Kauffman and Steph. Say hello to my machine at (617) 924-5221." (I'll assume somebody out there got that. I was lost after the second line. I guess he's not sure if he's married. Anybody out there know?)

**Jim Scutti** now works for General Electric Aircraft Engines in Lynn, Mass., as a materials applications engineer. He recently moved back East from southern California and is engaged to Bernadette Moran, R.N. They were to be married in June. (He sounded sure about that.) . . . **Dorian Jankowski** is in her third year of residency in pediatrics and will enter private practice in the fall, probably in Utah. In preparation she will

# the COMPUTER CARTOONed

Dan Berleant with Steve Damrel and Paul Sperry and also Scott Jackson and Andy Mathias and Dave McCalib



**Daniel Berleant, '81, is coauthor of a new book, the COMPUTER CARTOONed. It's not published yet, but**

**you can get a copy from him at the Computer Science Department, University of Texas, Austin, TX 78712.**

spend July backpacking in the Tetons and Wild Rivers of Wyoming.

Miriam and **Steven Glassman** wish to announce the birth of their first child, Emily Jane Glassman, last August 26. (Sounds like a member of the class of '09 to me!) Steven, Miriam, and Emily live in Framingham, Mass. . . . **Timothy Folster**, of Old Town, Maine, writes that he currently works for a large (unnamed) construction firm in northern New England involved in heavy and highway construction. As a general superintendent, he oversees 10 to 15 projects per year in the \$500,000 to \$5,000,000 range.

We also received a short note from **Pat Lat-terell**, who lives on New York's Upper East Side. I'll let him tell his own news: "I have been active in venture capital the past five years since receiving my M.B.A. from Stanford Business School, and am currently a general partner at Rothschild Ventures, Inc., in New York." . . . **Andrew R.Y. Lee** is now a consultant with Booz, Allen and Hamilton in Cleveland.

**Chien Huang** writes that, after a year and a half, he is pretty much settled on Long Island and learning how to be a homeowner. He and his wife recently finished renovating their kitchen—a two-month struggle! Chien thinks that next to babies, taking care of a house must be the most time-consuming activity. So far they have only the house to worry about. . . . We also received a short note from **Matt Steele** (Hi, Matt) saying that he married Randi Rosenberg in April 1987 (congratulations). They both work for Texaco in White Plains, N.Y., and live in Danbury, Conn. The (then-ongoing) Pennzoil litigation and unique (aren't they all?) Chapter 11 bankruptcy have made their work lives quite interesting. Matt recently completed a three-month stint as the treasurer's management assistant, and is currently working in the Pensions and Investments Divi-

sion setting up bond portfolios for Texaco's pension fund.

**Avery Desmond** was recently named assistant professor in the Department of Civil Engineering (at UMass/Amherst). She will be teaching in the environmental engineering program. Avery had been a research assistant in civil engineering since 1984 at Stanford (where she received her Ph.D.), and has also worked for the U.S. Geological Survey.

As for myself, I'm beginning to get busy with my own wedding plans (of all things!). I will be marrying Geoff Wall in October down in Philadelphia. Geoff is a Dartmouth grad, but has partially redeemed himself by attending the Sloan School for the past two years. We will be relocating to the Princeton, N.J., area in the near future.

Anyway . . . thanks to everyone who wrote this month. And, as always, keep those cards and letters coming! (Remember: the card in this issue of *Technology Review* makes it real easy!)—**Kate Mulrone**, Secretary, 256 Hampshire St., #3, Cambridge, MA 02139

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I hope that everybody is having a great summer. We are doing pretty well in the mail department these days. However, more is always better than less. So please take a few minutes out of your busy day and drop us a line!

**Bill Topazio** wrote to say that he is planning a Spring wedding. By the time this column appears, Bill will have married Lynn Schultz, a television producer. Bill claims to be still having fun at Editel in New York City. He is in the process of buying a co-op apartment in Brooklyn. Congratulations! . . . **Joan Horvath** is working at JPL in Pasadena, California, on parallel processing.



She just bought her first house. . . . **Chun-Chee Lau** recently joined AMEV Holding, Inc., a Dutch investment firm, in New York City as a financial analyst. He is enjoying it immensely so far. . . . **Dave Kates** graduated from Duke University's executive M.B.A. program in August 1987. Since that time, Dave moved to the D.C. area and joined IBM's Health Systems Group in Rockville, Md. Besides enjoying his new position, Dave is an avid runner, having completed the Marine Corps Marathon in an impressive 2:52:39 qualifying him for the Patriot's Day Marathon in Boston on April 18. If Dave takes the gold, I am sure that I will be able to convince the *Technology Review* to hold the presses, so we can get the whole story! Good Luck!

**Donald Jones** is living in Cincinnati, Ohio, where he has been with GPA Technical Consultants since last summer. He claims that Cincinnati housing prices are quite attractive compared to the Boston area. Donald claims that he and his wife were able to purchase a home for approximately one third the cost of a similar home in Boston. Unfortunately or fortunately there's no ocean or M.I.T. nearby and certainly no Boston Marathon! . . . Back in Boston, **Duane Nakahta** is stationed on the *USS Sam Rayburn* in the Charlestown Navy Yard. The *USS Sam Rayburn* is being converted to the Navy's first moored training ship for the nuclear training program. . . . **Harry Alwater** is living in Somerville, Mass., without his wife of almost two years, the former Teresa Fulker. Harry and Teresa were married on August 4, 1986, in a meadow on Bailey Island in Maine. Teresa is now a student at U.C. Berkeley so they claim to be supporting airlines and phone companies heartily. Last February, Harry finished and defended his Ph.D. thesis in E.E., and has been enjoying post-doctoral research at Harvard in the Division of Applied Sciences. He has accepted a position at Cal Tech to begin soon. Congratulations.

**George Dowd** has founded a real estate development company called IMT Equities, Inc., in southeastern Connecticut. He is specializing in commercial and industrial development as well as historical rehabilitation. George and his wife Laura have a one-year-old daughter Claire, and are expecting a second child in July 1988. . . . **Rick Heller** is living in the Berkeley, Calif., area. He received a master's in public policy from the Kennedy School at Harvard. Following graduation, he joined the California Public Utilities Commission. . . . **Victor Miller** continues to work for Loral Electronics Systems in Yonkers, N.Y., as a systems design engineer. . . . **Bill Wildeen** is just completing his residency in pediatrics at the University of Washington in Seattle. Thereafter, he will be a fellow in medical genetics at the same institution. He has been enjoying the fine Seattle weather and doing a lot of cycling and soccer. He is also trying to learn how to use computers, an area he somehow managed to avoid while at M.I.T.

**Alli Lee** reports that she is doing well. She gave birth to her first daughter at the end of August 1987 and passed the architecture licensing exam. . . . I had dinner with **Julie Neuringer** recently when she was in Boston interviewing for medical fellowship programs. She recently decided on the kidney transplant fellowship program at the Brigham and Women's Hospital in Boston. My husband Ned and I just returned from a wonderful week long vacation in California. After the beautiful sunshine, I look forward to the end of winter and beautiful spring and summer weather. Please keep those cards and letters coming.—**Lynn Radlauer Lubell**, Secretary, 216 Beacon St., Boston, MA 02116

## 82

I had dinner not long ago with **Rich Salz**, an honorary member of the class of 1982 since he started with us. Rich works at Bolt, Beranek & Newman Labs in Cambridge on Cronus, a dis-

tributed operating system. He is also writing a book on electronic mail. One of Rich's Cronus co-workers in **Paul Neves**. According to Rich, Paul should soon be competing on the European track circuit. Also at BBN Labs is **Terry Crowley**, who led the company's ultimate frisbee team to the finals. Terry is working on an electronic mail and configuring system. . . . Rich reports that fellow Pi Lam **Chris Aho** is living in Belmont, Mass., and working as the head of new product development for a small company that produces business software for Macs. . . . Finally, Rich mentioned that **Jon von Zelowitz** is living in San Francisco and working for Cubicomp, which makes graphic equipment for video production. Jon von spends his spare time working on his "handyman's special" house and playing with his band, The Mr. T Experience. The band's second album should be out by the time you read this.

I owe an apology to **Pat Kinney** for neglecting to mention that he was elected class vice-president at last summer's reunion. Pat is an assistant actuary at John Hancock in Boston and a fellow of the Society of Actuaries. He still plays clarinet in the M.I.T. concert band and is active with many local musical theater groups.

Sometimes the time lag in getting these columns published is annoying. For example, **Hajime Sano** writes that he is finishing up a master's in electrical engineering at the Jet Propulsion Lab, speed skating, restoring an old (c. 1910) house in Pasadena, and serving as unofficial West Coast alumni correspondent for his contemporaries from Theta Chi. He and Rick Russell, '86, co-organized the first two Beaver Cup hockey games between Caltech and M.I.T., the second of which took place at M.I.T. in February. Sadly, I can't tell you the outcome (M.I.T. 13, Caltech 0—ed.). . . . **Matthew Kalus** and his wife, Susan, were expecting their first child in February, but again I don't know what happened. . . . Please write and let us know!

Word from the Big Apple: **Alice Hoffman** is project manager for the development of a 45-story office/retail tower in Times Square at Broadway and 45th. Perhaps it will show up in the view of Manhattan from her newly purchased co-op in Brooklyn. . . . **Helen Kander** is an associate in the mergers and acquisitions department at Citibank, where she's been working on deals in which Hong Kong companies make acquisitions in the U.S.

**Joseph Romm** writes from Washington, D.C., that he won the 1987-88 American Physical Society's Congressional Scientist Fellowship. Joe is working for Rep. Charles Bennett (D-Fla.), who chairs the Seapower Subcommittee of the House Armed Services Committee and co-chairs the Democratic Task Force on the Strategic Defense Initiative. . . . In nearby Bethesda, Md., **Douglas Stevens** is doing research at the Naval Medical Research Institute. He recently became the father of Jaimie Marie Stevens, his first child.

Medical notes: **David Kushner** received his M.D. from Case Western in 1986, completed a one-year internship in internal medicine, and is just starting the second year of a four-year residency in diagnostic radiology at the University of New Mexico in Albuquerque. . . . **Megan Callahan** is in medical school at Boston University.

**Linda Custer** should soon be finishing her Ph.D. at Berkeley. . . . **Eric Bier** was also hoping to have his Ph.D. from Berkeley by now and to publish two papers at the SIGGRAPH computer graphics conference in August.

I thought being class secretary would be fun because I'd get lots of mail, but you're not writing. Please let us know how you're doing and what you've heard about classmates. Take a moment to write or call East Coast correspondent **Linda Schaffir** (18 Prospect Ave., Apt. B-2, Norwalk, CT 06850), West Coast Correspondent **Michelle Gabriel** (656 S. Fair Oaks Ave., D-211, Sunnyvale, CA 44086), or me.—**Stephanie Pollack**, Secretary, 33 Trowbridge St., Cambridge MA 02138

## 84

Greetings from the sunny shores of the Pacific! As you may or may not know, 1989 is our 5th reunion year. We are beginning to plan for this event now, and we need your help. If you have any suggestions for a reunion gift, please let me or the alumni office know! If you live in the Boston area and would like to be our reunion chairperson, please let me know! I want to make our 5th reunion a great one. Here's the news . . .

**Henri Meerman** is at the University of Texas studying for his Ph.D. in chemical engineering and also training for the triathlon. . . . **Scott Globus** is living in San Francisco and working as a location scout for a casting agent. . . . **Mike Agronin** got married this spring. . . . **Jeffrey Eisen** left Palladian Software in August to form a computer consulting company, "G.E.M. Associates," with two partners, one being Dinarte Morais, '86. The company is located in Kendall Square. . . . **Richard Reohr** is working in Oregon at Intel, as a hardware designer on IBM PS2s, and having lots of fun.

**Jeff Southworth** is currently enrolled at the University of Virginia as a first-year grad student pursuing an M.B.A. He previously worked for GM in Warren, Ohio, for three years. . . . **Mark Radlauer** is currently living in Brighton, Mass., with **Ed Martin**, and doing well. . . . **Suresh Subramanian** has just completed his Ph.D. in computer science and engineering at the University of Michigan.

**Erik Gilbert** is living in the Washington, D.C., area with Lou Martinage, '85. He just returned from working in London for four months. . . . **Hewon Hwang** is back in school at Stanford for a master's degree in manufacturing systems engineering.

**Theodore Sylvan** is self employed in real estate development in New York. . . . **Jeffrey Tipayer** works at Stanford flying airplanes over NASA/AF launch pads monitoring potential lightning strikes. . . . **Richard Lucas** is presently working at the Aerospace Corp. and finishing up a master's degree at UCLA in aerospace engineering. His wife, Caroline, is also attending UCLA in the astronomy department. . . . **Karen Welch** is at Harvard Business School with one more semester to go. She sees **Cheryl Whiteman (Brooks)** almost daily, as Cheryl talked her into running registration for the Annual Afro-American Career Conference. Karen is active in volleyball, student government, and the HBS version of MTG. After graduation (June '88), she'll probably go back to work for GM in Ohio.

Please write regarding the reunion. If you have any exciting ideas for events or just want to help out, drop me or any of the other officers a line.—**Diane M. Peterson**, President, 350 Palos Verdes Blvd., Apt. 20, Redondo Beach, CA 90277-6329

## 85

Hello! I'm now writing from Apple Computer. I started here in February and am really enjoying it. I am in the same group as Tony Masterson, '84—graphics hardware. . . . **Jeff Winner** also changed jobs; he is now at Oracle with many other alumni. . . . **Paul Gabuzda** is working on software to automate the process of designing computers at Unisys Corp. He is considering going to grad school for an M.B.A. this fall. He is currently living in Laguna Beach, Calif. . . . **Marie Cunningham** is up in Vancouver, Wash., working as a ceramic process engineer on a multilayer chip capacitor. When she's not working, she is sailing (mostly racing) or playing darts. . . . **Steve Meszaros** graduated from Stanford in June '86 with an M.S. in manufacturing systems engineering. He is currently an advanced manufacturing engineer at a Ford Motor Co. plant in Sandusky, Ohio. He is responsible for the introduction and implementation of advanced



manufacturing technologies on the factory floor. . . **Richard Willis** is in Burlington, Mass., working for a small (very small) engineering software company. Last fall, he married an old friend from high school and they are now living and loving in the Back Bay. He hopes to enter grad school somewhere this fall.

**Bob Cooley** has moved to Woburn, Mass. . . **John Juliano** is in Annapolis, Md., and **Craig Cartwright** is at Stanford. . . **Steve Huntley** is a weather officer at Yokota Air Base outside of Tokyo. He was assigned there after spending a year in the Air Force Basic Meteorology Program at Texas A&M. Tokyo reminds him of New York City, not as different as he expected. However he's heard that outside of Tokyo Japan is much more foreign.—**Stephanie Winner**, Secretary, 1026 Live Oak Dr., Santa Clara, CA 95051, (408) 985-6827

## 86

Hey dudes. We've been having some genius waves out here in southern California. Only received a few letters again. Let's go guys. Give me something to write about. This is your space.

**Chris Medina** is currently a division officer in the U.S. Navy on the U.S.S. *Merrill* (DD-976), a Spruance class destroyer. In charge of a 29-man division, he is preparing for his first overseas deployment. Chris lives in San Diego, Calif. . . **Stephen Johnson** left Hewlett-Packard on the West Coast to work on the East Coast as an independent contractor. He will be married to his school sweetheart this June. . . **Carla Fermann** is working at Project Athena with **Win Treese** as a user accounts consultant. She is currently living in Somerville, Mass.

**Mark Vandevoorde**, **Tom Huang**, and **Jim Petivan** are all at M.I.T. grad school and will be in the Battle of the Bands in early March. . . **Amy Lee** will be coming up from the University of Pennsylvania for the competition. Amy's studying math there but is thinking about transferring somewhere else. . . **Bill Saphir** visited M.I.T. in January. He's at the University of Texas, Austin, living with Dan Morgan, '85. Pat Jennings, '85, had a big get-together while Bill was there. . . **Aya Konishi**, who works at DEC in New Hampshire, was there as well as Charley Marker, '85, and Jon Rochlis, '85.

**Steven Merola** sent in an update on MacGregor B11 Suite. Stephen is a software engineer for Loral Electronics Systems in Yonkers, N.Y. . . **Roger Zee** and **Dexter Sealy** are systems programmers for DEC in Littleton, Mass. . . **Pete Loan** is getting his master's in mechanical engineering and computer science at Stanford, and **Steve Leduc** is attending University of California, San Diego, in search of his Ph.D. in mathematics. They'll all be getting together the last week of March for a ski vacation in Lake Tahoe.

**Douglas Smith** married Coleen Barry, '87, last May and spent their honeymoon in Barbados. Ken Szjada, '87, Chris Reed, '87, Michelle Hoofat, '87, and Karen and Jay Walsh (Next House tutors) all attended the wedding. After Barbados, Doug attended the Basic Course for the U.S. Army Chemical Corps. He is now settled in Newark, Del., working for Hercules, Inc., in process development.

**Costa Kokoropoulos** is alive and well, attending the University of Illinois in Chicago. . . Also attending are **Steve Kroft** and **John Port**. Costa wants to warn anyone coming to Chicago for the next two years that he'll be roaming the wards of several hospitals, so watch out! . . . **Carolyn Beer** became engaged to a fellow University of Illinois student, Dave Zerkle. She says she's still doing homework, studio, and playing ice hockey. Hoi-polloi lives! Also, she's planning a trip to Great Exuma, Bahamas, this June.

**Edison Wong** is in the middle of his second term at Columbia University College of Physicians and Surgeons. Walter Rho, '87, and Stephen Hoe-

nig, '87, are also there. He's says that **Paul Huang** and **William Shang** are in the New York City area putting their 6-A degrees to work. . . **Sonya Sakai** has set the date for her wedding: October 23, 1988, here in Rodondo Beach, Calif. . . **Grace Tan** will be going to Holland to support some meetings for JPL. She's also working for her master's at University of Southern California in aerospace engineering and, I'm told, has recently learned how to juggle. . . **Greg Harrison** ran the Los Angeles Marathon in March and tried skiing for the first time at Mammoth Mountain, Calif. He also got Larry Byrd's autograph when the Celtics were practicing at Loyola Marymount in preparation for the Lakers game.

**Tom Paterson** came out on business and had a chance to have dinner with me. He works for the Institute for Defense Analysis in Washington, D.C. Tom is doing well and has recently purchased a ferret. . . **Kevin Pryzbocki** gave me a call while he was on vacation in Manhattan Beach, Calif. He works for Bain & Co. in Boston along with **Brian Miller**. . . It seems that **Steve Jones** will be the first Delt to tie the knot. This will occur later this year.

I have been doing an enormous amount of travel. This being such a small world, it looks like I'll be working on a project with Lt. **Marilyn Oberhardt**, who currently works at the Air Force Geophysics Lab at Hanscom AFB, Mass. We might get a business trip to Italy together.

That's all folks. Stay tuned, same channel.—**Mary E. Cox**, Secretary, 1901 Rockefeller Ln. No. 2, Redondo Beach, CA 90278

## 87

Summer's finally here. That means the class of '87 has a year full of exciting stories to tell. Write me a letter so I can spread the word.

**Dave Carter** is traveling back and forth between New Mexico and M.I.T. doing research. . . **Dave Meir** is studying at Stanford University, and **Mary Minn** is in her first year of medical school. . . **C. Scott Dempwolff** is a construction project manager for Harold H. Hogg, Inc., in York, Pa., and he's loving it.

I got a lot of great mail. **Terry Huang** spent part of his Christmas vacation at Sargabush Mt. in Vermont with **Heather Beck**, **Alex Chow**, **Keveri Suryanaryan**, and **Kelvin Phoon**. Alex and Kaveri are both first-year medical students. Alex is studying at the University of Florida in Gainesville, while Kaveri is at Duke University in North Carolina. . . **Heather** is working for Candela, a laser company in Waltham, Mass. . . **Kelvin** and **Terry** are both attending graduate school at the University of Michigan at Ann Arbor. Kelvin is studying aeronautical engineering and Terry, electrical engineering.

**Kip Fern** is finishing up his master's in VI-3 (he's in the co-op program with IBM). . . **Valerie Brown** is in the M.D./Ph.D. program at the University of Pennsylvania. . . **Mike Judy**, **Dave Weitz**, and **Mark Mastandrea** are all attending graduate school at the University of California at Berkeley. Dave and Mark are both in the Chemistry Department, and Mike is in the Electrical Engineering Department.

**Neil D. Cudmore** is living in Woburn, Mass., and is teaching Spanish in a regional high school. Rumor has it that his students love him. . . **Lori Locascio** and **Rick Poyner** are blissfully married and living in lovely Somerville. Lori is working for the Commonwealth of Massachusetts, Division of Capital Planning and Operations, and Rick is working for ICS/Telegraphics, a software company in Cambridge.

**David Schultz** wrote from Seattle to give an update on some Chi Phi's. Dave is a grad student in atmospheric science at the University of Washington. In his estimation, it's a lot tougher than M.I.T. His first publication has just gone through the galleys. Look for Wilkens, Schultz, and Carlson in *Proceedings of the Deep Sea Drilling Program* Vol. 102B next year. Dave is also getting

involved in women's basketball since he met one of the players in his dorm. He's also joined a track club in order to get back into some serious track and road racing shape. . . **Al Canghualua** is a grad student at M.I.T. in aero/astro. . . **Bill Irving** is working at Lincoln Labs. . . Al and Bill are living with **Blake Leverett** in Arlington. Blake will be married in June. . . **Steve Sherwood** is living a block from the beach in San Diego and works for the electronics firm, Mission Research. . . **Jim Gotshalk** is working at JPL in California.

**Neal Hoyer** is a grad student studying mechanical engineering (working on cell biomechanics for his master's research in a joint effort with the biochemistry department at the medical school) at Washington University in St. Louis. . . **Michelle Kirshen** is having fun at Emory Medical School in Atlanta. She's loving anatomy and playing bass clarinet in the wind ensemble. . . Another medical school student, **Steven McCune**, is at University of Alabama, Birmingham, in an M.D./Ph.D. program. He's doing quite well and enjoying Dixie. . . In Chicago, **Betsy Parker** is working at Kraft and singing in a local choral society.

**Connie Moy** is at GTE in the Chicago area. . . **Dave Graham** and **Pam McHatton** are at Northwestern in mechanical engineering and material science. . . Moving west, **Al Meyer** is at Stanford in civil engineering. . . **Steve Berczuk** is also in the California area. . . **Debbie Washington** is faring well there, too, as an electrical engineer through a scholarship from Bell Labs. . . **Adam Kane** is working at Bell Labs and working on an M.S.M.E. at Stevens. He's probably writing all the A&T "yuppie nightmare" ads. . . **Anne Satterthwaite** is enjoying Harvard biology, where the labs have fireplaces (well, almost). . . **Amy Bertin** is living in her element in California and planning to start studying economics at Harvard in the fall of '88.

**Ryan C. Fong** is working in Sacramento, Calif., for River West Developments, a land development and building company, as a project assistant.

**George Mitsuoaka** is working for a startup, Stellar Computer, putting in typical startup hours. The company just announced its product, the GS-1000, which is the world's first graphics supercomputer. George is living in Cambridgeport and still makes it over to M.I.T. regularly to work out with the fencing team and visit friends.

**Patty Manning** wrote a great letter filled with information. She's at UC Berkeley ("the cool people call it CAL") grad school in mechanical engineering with **Derek Aquil**, **Dana Takaki**, and **Bill Messner**, '84. Patty and Dana are rooming with **Maria Galiano**, who is in the Material Science Department with Ron Reade, '84. . . **Mimi Bloom** is living in Mountain View and working at Applied Decision Analysis in Menlo Park. . . **Susan Zarzecny** and **Bob Broderson** live in San Mateo. Susan works in the city, and Bob works at Oracle. . . **Amy Austin** is at M.I.T. completing her master's and is living with **Betsy O'Neill**. Betsy plans to start working on her Ph.D. in biology in September.

**Kathy Millier** is joining the Peace Corps this summer. She will be teaching math in the Central African Republic. . . **Pierre Chevray** is at Johns Hopkins Medical School. . . **Sean Tierney** works for a software company in Cambridge. . . **Andrew Ferency** is at M.I.T. grad school in electrical engineering and computer science. . . Maria and Patty hosted a totally hopping party with Bill Messner, '84. Many M.I.T. friends attended: Mimi, Susan, Bob, Derek, Ron, and Dana, as well as **Randall Honke** and **Julia White**. Randall is a mechanical engineering grad student at UC Berkeley, and Julia lives and works in Berkeley. . . **Steve Russell** is attending Cornell grad school in material science. He's also becoming quite a ski bum.

That's all the news I have for now. Thanks so much for all your help. The letters were great; keep them coming!—**Stephanie Levin**, Secretary, 3201 Eighth St., Charlestown, MA 02129, (617) 242-1618

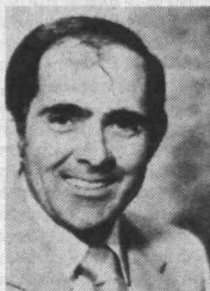




## COURSE NEWS



M. S. Schultz



F. P. Incropera

### I CIVIL ENGINEERING

**William J. LeMessurier**, S.M.'53, chairman of LeMessurier Consultants, Inc., Cambridge, is one of 12 new honorary members of the American Institute of Architects. LeMessurier was recognized as an expert and innovator in engineering high-rise structures and as co-founder of the Boston Foundation for Architecture, devoted to advancing public appreciation and understanding of architecture—"a peerless contributor, strengthener, and advocate" of architects and architecture, said the citation.

Assistant Professor **Alexander H. Slocum**, Ph.D.'85, was honored with a 1988 Presidential Young Investigator Award late last spring from the National Science Foundation.

**James P. Gould**, S.M.'46, **Frank L. Parker**, '48, and **Ignacio Rodriguez-Iturbe** were honored by election to the National Academy of Engineering late last spring. Gould, who is a partner in the engineering firm of Mueser Rutledge, New York, was cited for "major contributions in the application of geotechnical theory to underground and construction"; Parker, professor of environmental and water resources engineering at Vanderbilt University, for "world leadership in the development of information required for the safe disposal of high-level radioactive waters"; and Rodriguez-Iturbe, a visitor in the department at M.I.T. this year from his post as professor of engineering at the Instituto Internacional de Estudios Avanzados, Caracas, Venezuela, was named a foreign associate of the academy for his leadership in hydrologic research and education.

Rear Admiral **Harry N. Wallin**, S.M.'37, writes from San Mateo, Calif.: "Still enjoying retirement, traveling locally and overseas. Play golf two to three times each week. My wife is also in good health and enjoys our frequent trips." . . . **Louis M. Wenick**, S.M.'77, is president of Technical Service Systems, Inc., Panama City, Fla., specializing in engineering consulting and electronic systems construction. Wenick is also on the Board of Directors of the Liberty Savings Bank, Tallahassee.

**Roy S. Morgan**, S.M.'80, reports from Derwood, Md., that he is now at the National Bureau of Standards' Institute for Computer Science and Technology.

Many reports for this issue from our interna-

tional sector. **Jorge Graells Ferrandez**, S.M.'77, writes from Barcelona, Spain: "Institut Cerda, the non-profit research institution of which I am the director, is finishing two-year (\$1 million each) projects on impacts of ISDN in Spain and hazardous waste management in Catalonia. Now we begin a three-year EEC \$3 million project with British Telecom as well as several projects on intelligent buildings, ISDN applications, hazardous waste cleanup, small generators, and commercial distribution in Barcelona." . . . In another report from Spain, Major General **Joseph P. Franklin**, S.M.'61, writes from Madrid that he retired from the U.S. Army in August 1987 to begin his own Spanish consulting company, Franklin, S.A. The firm specializes in government, business, and joint ventures among the United States, Spain, and third world countries.

**Eric F. Peyrard**, S.M.'82, writes from Paris with some news from fellow (France-based) civil engineering alumni: "**Patrick Jaillet**, Ph.D.'85, was married to Tina last summer and among the guests I was pleased to see **Antoine Jezequel**, S.M.'85. **Michele Cyna**, S.M.'81, is expecting a second baby and **Sebastien Thiriez**, S.M.'83, is going back to the United States to work for the World Bank." . . . **Peter P. Macke**, S.M.'85, is a vice-president with Deutsche Bank AG's Project Finance Group, located in New York for the past year.

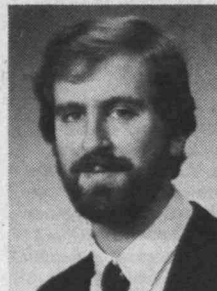
**Lionel Bauduy**, S.M.'69, writes from Port-Au-Prince, Haiti: "I am still with Tecina S.A., an architecture and engineering construction company I helped found (in Haiti) in 1974. We have been successful in innovating a good deal in the local market for those services."

**Thomas Robert Kealey**, S.M.'47, writes from Wormsleyburg, Penn.: "I was managing partner of Modjeski & Masters C.E. until my retirement on September 30, 1986. I now serve the firm as a consultant." . . . **Elliot Steinberg**, S.M.'80, is principal of the Geotechnical Group, Inc., Needham, Mass.

**Saul Arnold Nuccitelli**, '60, a registered professional engineer and licensed land surveyor in Springfield, Mo., has been listed in the 45th edition of *Who's Who in America*. Highlights of Arnold's career: (1954-55) project engineer, H.B. Bolas Enterprises, Denver, Col.; (1955-58) assistant professor, research engineer, University of Denver; (1958-60), staff member, M.I.T.; (1960-62) assistant professor of engineering, Cooper Union, New York City; (1962-present), private practice in consulting engineering, Springfield, Mo. A fellow of ASCE, Arnold was named Missouri Construction Engineer of the Year (1973) and is a past president of the Ozark Chapter of the Missouri Society of Professional Engineers.

**Michael S. Schultz**, S.M.'81, has been made an associate at SEA Consultants, a Cambridge-based engineering/architectural firm. Schultz will serve as associate-in-charge of hazardous waste management projects, geotechnical engineering, geology, and hydrogeologic assignments.

**William Fish**, Ph.D.'84, has been appointed an assistant professor in the Department of Environmental Science and Engineering at the Oregon Graduate Center, Beaverton.



K. Meltsner



E. S. Macias

### II MECHANICAL ENGINEERING

A plethora of honors has come to **Arthur E. Bergles**, Ph.D.'62, who is Clark Crossman Professor of Engineering at Rensselaer Polytechnic Institute. In June 1987 the American Society for Engineering Education gave him its highest recognition, the Lamme Award. Then came the Ralph R. Teetor Award of the Society of Automotive Engineers for distinguished service in engineering education. More recently Bergles has been named to foreign membership in the Polish Society of Theoretical and Applied Mechanics and to the grade of fellow in the American Association for the Advancement of Science.

**John H. Lienhard**, assistant professor in the department at M.I.T., has been chosen for a 1988 Presidential Young Investigator Award by the National Science Foundation; he'll enjoy substantial research funding from NSF and other sources during the five-year grant period. . . . **Caroline Whitbeck**, Ph.D.'70, lecturer in the department who specializes in professional and ethical issues, has been named a fellow of the American Association for the Advancement of Science.

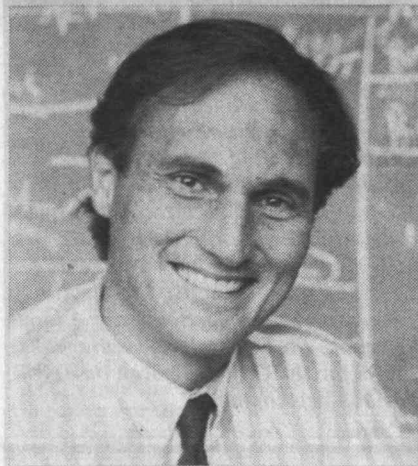
**Frank Incropera**, '61, on the faculty in mechanical engineering at Purdue University since 1966, has been named assistant dean for graduate education and research in Purdue's Schools of Engineering. His recent research has been in the fields of heat transfer and materials processing.

. . . **Dong-il Cho**, Ph.D.'88, has been appointed assistant professor in the Department of Mechanical and Aerospace Engineering at Princeton. In 1984 and 1985 Cho was a summer intern at General Motors and he has also served as a consulting engineer at Daewoo Motor Co., Korea. . . . **Adrian Bejan**, Ph.D.'75, professor of mechanical engineering and materials science at Duke University, Durham, N.C., has been named a fellow of the American Society of Mechanical Engineers.

**Reginald L. Gott**, S.M.'85, writes from Harwich, England: "(After graduation), I spent two years working in West Germany developing computer-integrated machining systems, mainly for the U.S. market. Since September 1987 I've been in England as project executive for Portals Engineering, Ltd., Essex, developing a manufacturing strategy and techno-commercial aspects of corporate strategy for the Engineering Division."



## Droege's Plan to Transform Kawasaki Wins International Competition



P. Droege

**P**eter Droege, M.A.A.'78, was awarded the Grand Prix of the 1987 "International Concept Design Competition for an Advanced Information City" in Kawasaki, Japan. More than 200 entries had been submitted world-wide for this contest, sponsored by the Japan Association for Planning Administration and the Mainichi Newspapers of Tokyo.

The aim of the event was to generate ideas for the transformation of industrial Kawasaki, population 1.1 million, into a livable city that functions as an integrat-

ed learning environment. The competition is part of an ongoing effort to find means of allowing social ideals to influence technological innovation, urban development, and city form. In the final preparations of his design, Droege was backed up by a team of M.I.T.-based advisors: Professors Leo Marx, Lisa Peattie, Otto Pieni, and William Porter, Ph.D.'69, as well as environmental designer Julie Messervy and computer graphics consultant Winifred Richmond.

Droege will also be one of the participants in a month-long international workshop on urban development and design in the "age of the advanced information society," a concept much talked of in Japan at present. The workshop, entitled "The Information City," will be held in Japan in August 1988. It is jointly sponsored by the M.I.T. East Asian Architecture and Planning Program (EAP) (of the School of Architecture and Planning) and the Japan Association for Planning Administration, with support from the Department of Social Engineering at Tokyo Institute of Technology.

Last year, Droege was a consultant to the United Nations Development Program (UNDP) on missions to the Middle East and West Africa. In 1988, he expects to work on an UNDP project in Uganda. □

**George S. Reichenbach**, Sc.D.'56, of Carlisle, Mass., reports that he has retired from Norton Co. as vice-president—bonded abrasives and joined Advent International, a major Boston venture capital firm. Reichenbach specializes in finding investment opportunities in advanced materials.

**Jose U. Jovellanos**, S.M.'43, reports from Manila that he left government service (Philippines National Oil Co. and National Power Corp.) in May 1986; he is currently president of Engineering and Development Corp. of the Philippines, engineering consultants; principal of J.U. Jovellanos and Associates business consultants; and president of Phinma-EDCOP-Diaz International Corp.

**Jon Andresen**, S.M.'73, writes from Oakland, Calif.: "Job change from trains to planes as I moved from Southern Pacific Railroad to United Airlines. The senior technical analyst position involves bringing new technologies into the airline business—very exciting!"

**Atilla T. Alptekin**, S.M.'66, is chairman and chief executive officer of a textile manufacturing and marketing group in southern Turkey. Alptekin lives in Adana with his wife Zihniye and 16-year-old son.

**Donald J. Spooner**, S.M.'52, of Himrod, N.Y., reports that he retired from Eastman Kodak Co., and moved to a new home which he designed and is building on Seneca Lake in New York.

**Sherman W. Betts**, S.M.'41, a retired United States Navy captain living in Whispering Pines, N.C., writes that he is president of the Sons of the Revolution in the state of North Carolina.

**Joseph C. Batty**, Sc.D.'69, writes that he is teaching in the Mechanical Engineering Department at Utah State University and studying the response of composite materials to thermal loadings. Specifically, his current project is thermal analysis of cryogenically cooled instrument packages for Utah State's Center for Space Engineering and Space Dynamics Laboratory. . . . **Ronald Nitschke**, S.M.'87, writes, "After graduating in June 1987, I returned to General Motors as a senior project engineer in the 2.5L Engine Development Group. I am currently involved with valve train, induction system, and engine heat transfer projects." Nitschke lives in Drayton Plains, Mich.

**Frederick S. Kenney, Sr.**, M.E.'16, who worked for more than 20 years at the former family-owned Kenney Manufacturing Co. in Baldwinville and Winchendon, Mass., until his retirement in 1960, passed away last February 10. In addition to his work with the family company, Kenney served, for 15 years until his retirement in 1957, as an inspector for General Electric Co., Fitchburg.

The Japan Endowment Fund of M.I.T.'s Center for International Studies will support Professor **Thomas W. Eagar**, Sc.D.'75, of M.I.T. in continued collaborative research with the Welding Research Institute of Osaka University.

The Board of Governors of Acta Metallurgica, Inc., has established a major award in memory of the late **J. Herbert Hollomon**, Sc.D.'46, to recognize significant contributions "to understanding the interactions between materials and societal concerns." Hollomon was the principal instigator of the journal *Acta Metallurgica*, the first of the three international journals now published by the organization in the name of 27 professional societies worldwide. His career included service at General Electric, as assistant secretary of commerce, as president of the University of Oklahoma, and on the faculties of M.I.T. and Boston University.

**Praveen Chaudhari**, Sc.D.'66, vice-president and director for the physical sciences of the IBM Thomas J. Watson Research Center, was named to the National Academy of Engineering late last spring; he was cited for contributions to materials science and electronic materials. . . . **Seigo Matsuda**, Sc.D.'61, has been assigned (since January 1987) as president of Nippon Jarrell-Ash, Inc., a subsidiary of Thermo Electron Co., stationed in Kyoto, Japan.

**Kenneth J. Meltsner**, Ph.D.'88, has joined the General Electric Research and Development Center, Schenectady, N.Y., as a materials scientist.

. . . **Richard J. Brook**, Sc.D.'66, reports that last March 1 he moved to Stuttgart, West Germany, to take an appointment as director and scientific member of the Max Planck Institute for Metals Research. Previously, Brook was professor and head of the Department of Ceramics at the University of Leeds, England. . . . **Janine J. Weins**, Ph.D.'70, writes from Lebanon, N.H.: "I recently joined an intellectual property consulting business to assist small clients develop business plans that include options for protecting and promoting patents, copyrights, and trade secret information."

**James H. McMahon**, '50, passed away in Ridgecrest, Calif., on December 21, 1987; no further details are available.

## IV ARCHITECTURE

A new tool for motivating political action was proposed this spring by graduate students in the M.I.T. Design and Housing Program—marionettes. A noon-hour show in the lobby of Building 7 had two-foot-high dolls dressed in traditional Sri Lankan garb enacting the story of how hard-working peasants had finally been moved to improve their lives through community projects. People need to realize that they "have to help themselves," that some problems are "too big a burden for the government to handle," explained graduate student **Sebastian Gray** to Paula Maute of *The Tech*.

Membership in the College of Fellows of the American Institute of Architects came to **Yu Sing Jung**, M.Arch.'62, of Wellesley, Mass., last April. Jung is president and co-founder of Jung/Brannen Associates, Inc., Boston, a major full-service architectural firm.

M.I.T.'s East Asian Architecture and Planning Program (EAAP) will co-sponsor "The Information City," the first International Workshop on Urban Development and Design in the Age of the Advanced Information Society, in Kawasaki, Japan, this summer from August 1 to 26. Sessions will explore "the concepts, development strategies, and social opportunities of cities as they emerge in the 21st century," according to Michael Joroff, coordinator of EAAP. Co-sponsors are the Japan Association for Planning Administration



and the Department of Social Engineering at Tokyo Institute of Technology. For further information: (617) 253-1350.

Two members of the department at M.I.T. were co-chairmen of a symposium on "Computers in Design—Emerging Research Directions" for SKOK Systems, Inc., last April in Chicago. The program, planned by Patrick Purcell, visiting associate professor in the Media Arts and Sciences Section, and Frank Miller, assistant professor of architecture, included sessions on academic-industrial interfaces, working groups on major research issues, and international case studies.

Nina V. Brew, S.M.'86, and Altaf Mulla, S.M.'84, have been named associates of Arrowstreet, Inc., Cambridge, architects and planners. . . . John Dale, S.M.'86, writes that he moved to Los Angeles in July 1986 to work for Barton Myers Associates and in September 1987 was made an associate. Dale was co-author of "Sunday Architecture," in the December 1986 issue of *Space and Society* magazine. . . . Since graduation Salley Sweetland, M.Arch.'86, has been painting and teaching in watercolor, oils, and collage. She is a fellow at the Virginia Center for Creative Arts in Sweet Briar, Va., has participated in two residencies, and has been showing her work in the mid-Atlantic region for the past several years.

Masanori Nagashima, M.A.A.'76, writes from Tokyo that last June he became the president of ARC Yamagiwa, Inc., marketing CAD systems in Japan. The firm also develops systems for architectural design and markets McDonnell Douglas GDS software in Japan. . . . Ronald Fergie, S.M.'86, is currently a software designer for Skidmore, Owings & Merrill, Chicago, where he is developing software for lighting and electrical analysis for an integrated architectural/engineering computer-aided-design package. . . . Michael Woods, S.M.'84, has recently joined James Stewart Polshek and Partners in New York.

Todd L. Siler, Ph.D.'86, writes from Cambridge: "I'm happy to report that one of my artworks is now in the permanent collection of the Solomon R. Guggenheim Museum in New York City. Also, another major work is being considered for the 20th Century art wing of New York's Metropolitan Museum of Art. In addition to creating new works for my art exhibitions, articles, and books, I'm developing an invention for producing design patterns in materials. My patent application is expected to result in the issued patent in the near future. (Thanks M.I.T. for all the great support!)"

Everett A. Glendenning, M.Arch.'54, writes from Cincinnati, Ohio: "Both sons are architects. Jim is in Minneapolis (B.Arch. from Miami of Ohio, M.Arch. from University of Minnesota); Tom is back in school getting his M.B.A. at Harvard (B.Arch. from Virginia, M.Arch. from Yale). Nice that he got in the second-best school in Cambridge. . . . Takashi Arioka, S.M.'86, writes from Ayaseiichi Kanagawa, Japan: 'I was invited to the Architectural Design Conference '87, Kurobe, Japan (November 20-21, 1987), as an observer. Richard Rodgers was the main guest commentator in this conference. More than 300 architects and interior designers born in the 1940s and 1950s were there to discuss the possibilities of new interfaces of architecture and technology.'"

## V CHEMISTRY

To Keith A. Nelson, associate professor of chemistry at M.I.T., the 1988 Coblentz Award of the Coblentz Society, formed to foster understanding and application of infrared spectroscopy. The \$1,000 award recognizes outstanding work in spectroscopy by a scientist under the age of 36.

Peter G. Schultz, associate professor of chemistry at the University of California at Berkeley who held a postdoctoral appointment at M.I.T. in 1984, is winner of the 1988 Alan T. Waterman Award. It's presented annually by the National Science Foundation to a scientist or engineer under 35 for

research showing extraordinary quality, innovation, and further potential for discovery. . . . M.I.T. Professor Robert W. Field was honored in April with the Earle K. Plyer Prize of the American Physical Society for "seminal contributions to molecular spectroscopy," including techniques that make visible many molecular phenomena previously inaccessible.

The Theodore William Richards Medal of the American Chemical Society was given to Walter Stockmayer, Ph.D.'40, Albert W. Smith Professor Emeritus of Chemistry at Dartmouth, at ceremonies of the Northeastern Section of ACS early last spring. Stockmayer responded with a paper on the field of his principal professional interest: "Adventures with Chain Molecules."

Stephen L. Buchwald, Rogers and Georges Firmench Career Development Assistant Professor of Natural Products Chemistry at M.I.T., has received an American Cancer Society grant for research on the synthesis of chemical compounds for medicinal use. And a similar grant has come to Katherine L. Puckett, postdoctoral fellow in the department at M.I.T., for work on cellular responses to external biological signals. Buchwald has also received a \$25,000 Alfred P. Sloan Research Fellowship for 1988.

David W. Ellis, Ph.D.'62, president of Lafayette College, Easton, Penn., has been elected chair of the Board of Directors of the National Association of Independent Colleges and Universities. Ellis is completing 10 years at Lafayette. . . . Edward S. Macias, Ph.D.'70, chairman of the Department of Chemistry at Washington University, St. Louis, has been named associate provost for science and technology. . . . To Byron G. Hays, Ph.D.'64, technical director for publication offset inks at the BASF Corp., Inmont Division headquarters, Clifton, N.J., a \$1,000 prize from the National Association of Printing Ink Manufacturers. Hays was honored for his technical paper in *American Ink Maker* (October 1986) on "A Model for Organic Pigments in Oil or Water Based Printing Inks."

Richard A. Durst, Ph.D.'63, writes from Clarksburg, Md.: "This has been an eventful year in which I was elected secretary of Commission V.5 (electroanalytical chemistry) of the International Union of Pure and Applied Chemistry; named chairman of the first Gordon Research Conference on Bioanalytical Chemistry and named editor of their newsletter; and also named chairman of the Area Committee on Instrument Systems of the National Committee for Clinical Laboratory Standards. To top it all off, I was awarded the Department of Commerce Silver Medal for Meritorious Federal Service." Durst is associated with the National Bureau of Standards' Center for Analytical Chemistry.

Cryst Scott Blackwell, Ph.D.'71, senior research associate in Union Carbide's Central Scientific Laboratory, was named head of the NMR Skill Center at the Union Carbide's Tarrytown, N.Y., Technical Center. . . . Manfred Kappes, Ph.D.'81, is assistant professor of physical chemistry at Northwestern University, Evanston, Ill.

## VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

To William M. Siebert, Sc.D.'52, Ford Professor of Engineering at M.I.T., the Pioneer Award of the IEEE Aerospace and Electronic Systems Society. The award is to identify significant contributions to aerospace and electronic systems made at least two decades ago that continue in use today, and Siebert was honored for his work in phase-coded pulse compression to increase the resolution in high-power radar systems. A co-winner, Charles E. Cook of Mitre Corp. was cited for work on frequency-modulated pulse compression.

We record with pride the election of four members of the M.I.T. EECS community to the National Academy of Engineering late last spring:

□ Robert W. Brodersen, Ph.D.'72, professor of electrical engineering and computer science at the University of California at Berkeley, for work



*As a leading proponent of people's involvement in the design of their environments, Rod Hackney (left), president of the Royal Institute of British Architects and architectural advisor to Britain's Prince Charles, came to M.I.T. last spring to lead a three-day workshop on community architecture. Among workshop participants: Andrew Slettebak, Ph.D.'87 (right), senior architect for the City of Boston on neighborhood development.*

on very-large-scale integrated circuit design and speech-processing.

□ Barbara H. Liskov, NEC Professor of Software Science and Technology at M.I.T., for "pioneering contributions to programming languages, software methodology, and distributed operating systems."

□ Sanjoy K. Mitter, professor of electrical engineering and director of the M.I.T. Center for Intelligent Control Systems, for "outstanding contributions to the theory and applications of automatic control and nonlinear filtering."

□ Ronald R. Parker, Sc.D.'67, professor of electrical engineering for "leadership in the engineering and experimental science of tokamak plasma fusion systems. . ." (Just as the NAE's honor was announced, Parker was promoted from associate director to director of the M.I.T. Plasma Fusion Center; it's rated as "one of the leading university research laboratories in the physics and engineering of magnetic confinement fusion," and Parker has been a major participant in its work for more than a decade.)

M.I.T.'s Assistant Professor Raphael A. Lee, who holds the Carl R. Van Tassel Career Development Chair, is among "Black Achievers in Science" cited by the Chicago Museum of Science and Industry. Lee is also assistant professor of plastic surgery at Harvard Medical School, and his work is on how mechanical and electrical signals regulate the growth and development of living organisms. . . . The Engineering Societies of New England honored Institute Professor Mildred S. Dresselhaus of M.I.T. with the New England Award during the 1988 Engineers Week in Boston. The award is designated for a New England engineering professional "who by outstanding character and achievement merits recognition by fellow engineers."

### VI-A Internship Program

With this writing the acceptances for VI-A's 71st class, to start in June 1988, are essentially complete and are expected to number 84. The selections have been made from among 154 applicants representing 54.5 percent of this year's Course VI sophomores. According to Director Kevin O'Toole, "The selection process has come to a very successful conclusion."

An educational honor of distinction came to Professor Alan V. Oppenheim, Sc.D.'64—the IEEE Education Medal. His citation reads, "leadership



in engineering education through teaching, textbooks, and video tape series in digital signal processing." Alan is a former Cecil and Ida Green Professor in EE&CS, this also being appropriate to VI-A in light of Cecil H. Green's '23 affiliation with the Program. Back in 1986 a winner of this prestigious IEEE Education Medal was Professor **Richard B. Adler**, Sc.D'49, current associate department head for electrical science and engineering, also a VI-A graduate!

Many of you in the computer field probably have followed the establishment of two new firms: Ardent and Stellar. **C. Gordon Bell**, S.M.'57, well-known leader in the computer field, has joined Ardent Computer, Inc. as vice president of engineering and research and development. Stellar Computer, Inc. has been founded by **J. William Poduska**, Sc.D'62, a founder of PRIME and Apollo.

In a conversation with **Stephen N. Zilles**, S.M.'70, of IBM's Almaden Research Center, San Jose, Calif., I learned that **Juri Matisoo**, S.M.'60, is now the director of that center.

A panel discussion on "Microwave Applications of High-Temperature Superconductors," announced in the IEEE Boston Section's *The Reflector* for April 1988, includes **Richard S. Withers**, Sc.D'78, associate group leader in the Analog Device Technology Group at M.I.T.'s Lincoln Laboratory. Rick was by the office one afternoon and we had a pleasant reunion.

M.I.T.'s Industrial Liaison Program sponsored a symposium early this year on "Opto-Electronics: Devices & Applications" chaired by Institute Professor **Hermann A. Haus**, Sc.D'54. One of the symposium speakers was **Vincent W. S. Chan**, Ph.D'74, from Lincoln Laboratory.

One afternoon in March I had a call from **Steven M. Leibiger**, S.M.'84. Steve's with National Semiconductor in Puyallup, Wash. This was originally a division of Fairchild prior to the merger. Steve did his VI-A work at Fairchild/South Portland along with a classmate **John R. English**, S.M.'84. Steve tells me John works for Polaroid, Cambridge, Mass., and is now married.

**Leonard N. Evenchik**, S.M.'79, came by one afternoon to tell me about his new job. He has been made director of data communications in the Executive Office for Administration and Finance, working for Massachusetts Governor Michael Dukakis. He had originally been with B & N and then did some consulting work prior to taking this state government position.

Since last writing I've also had interesting conversations with **Geoffrey J. Bunza**, Ph.D'81 (Mentor Graphics, Beaverton, Ore.); **John D. Chisholm**, S.M.'76 (Consultant, Menlo Park, Calif.); **John F. Cooper**, S.M.'76 (Personics, Inc., Menlo Park, Calif.); **Edward C. Giaimo**, S.M.'75 (Zetron, Inc., Bellevue, Wash.), and **H. DuBose Montgomery**, Ph.D'81 (Menlo Ventures, Inc., Menlo Park, Calif.). Bunza told me that **Stephen Swerling**, '63 (co-founder and vice-president of Mentor Graphics), has new company responsibilities interfacing with Tektronix, from whom Mentor has just taken over their CAE and CASE business.

Other visitors to the VI-A Office, since last writing, have been **Dean R. Collins**, S.M.'59 (Texas Instruments, Dallas), **Scott Cutler**, Ph.D'76 (Landy Electronics, Ft. Worth), **Imre Gaal**, S.M.'86 (medical school, Dartmouth College), **Steven K. Ladd**, S.M.'81 (Raychem Corp., San Jose, Calif.); **Karl M. Lofgren**, S.M.'77 (Western Digital, Irvine, Calif.); and **Gary K. Montress**, Ph.D'77 (Raytheon Research, Lexington, Mass.).—John A. Tucker, Special Assistant to the Department Head, for VI-A and Lecturer, M.I.T., Room 38-473, Cambridge, MA 02139

## VIII PHYSICS

Trapping atoms is a specialty of **David Pritchard**, professor of physics at M.I.T.—an extremely fast-developing field in which new records for the

numbers of atoms trapped, their density, and confinement time are frequent events. Pritchard described his work, in which laser light is used to capture atoms with strong optical absorption lines, for the Lasers and Electro Optics Chapter of the Boston Section, IEEE, last April.

For "original and pioneering studies that revolutionized seismic wave analysis," **Jon F. Claerbout**, Ph.D'67, professor of geophysics at Stanford, was elected to the National Academy of Engineering early this year.

**Robert J. Birgeneau**, professor of physics at M.I.T., this summer succeeds Professor **Jerome I. Friedman** as head of the department. Friedman, who has been head for five years, returns to full-time teaching and research as the first holder of the William A. Coolidge Professorship, established this year to honor Coolidge for his long-time service to M.I.T. as a member of the Corporation and many of its visiting committees. Birgeneau came to the department in 1975 from the technical staff at Bell Laboratories; his degrees are from the University of Toronto and Yale. A leader in the field of condensed matter physics, Birgeneau has been the Cecil and Ida Green Professor since 1982.

A preview of a new National Research Council report was provided by two of its M.I.T.-based authors for the American Astronautical Society's 26th Goddard Memorial Symposium in Greenbelt, Md., early last spring. Professor **Rainer Weiss**, Ph.D'62, spoke on "Space Science in the 21st Century" and Professor **Bernard F. Burke**, Ph.D'53, on "The Technology Challenge of Future Space Missions."

Two major awards came to Professor **Bruno Coppi** of M.I.T. last spring: the American Physical Society's James Clerk Maxwell Prize for Plasma Physics and the Dante Gold Medal of Italy's Dante Alighieri Society. For the Maxwell Prize Coppi was cited for "outstanding contributions to fundamental theory, experimental interpretation, and engineering design in fusion research," and the Dante Medal was for "excellence in physics and education." . . . Meanwhile, M.I.T. Professor **Samuel C. C. Ting**, who won the Nobel Prize in Physics a decade ago, was picked last spring for the 1988 De Gasperi Prize in Science, the most prestigious award given by the Italian Republic. Ting was cited for his contributions "to one of the most advanced sectors of peaceful research" and for his promotion of "international collaboration for a science without secrets and without frontiers."

Professor **Ronald C. Davidson** has returned to full-time teaching and research after a decade as director of the M.I.T. Plasma Fusion Center. It was a period of "extraordinary" progress, says **Kenneth A. Smith**, Sc.D'62, M.I.T. vice-president for research.

Two members of the department at M.I.T.—Assistant Professors **Edmund Bertschinger** and **Nicholas P. Warner**—have been selected for \$25,000 Alfred P. Sloan Research Fellowships for 1988. . . . And two members of the department have been named fellows of the American Association for the Advancement of Science, **George B. Benedek**, Alfred H. Caspary Professor, and **Henry W. Kendall**, Ph.D'55.

**Vincent Salmon**, Ph.D'38, reports from Menlo Park, Calif., that he retired from SRI International in 1976 and is still serving as an acoustical consultant and consulting professor at Stanford. Salmon received the 1985 Silver Medal in Engineering Acoustics from the Acoustical Society of America.

**Lyle A. Cox**, S.M.'53, is currently deputy associate director at the Lawrence Livermore National Laboratory, Livermore, Calif. . . . **Robert D. Kaplan**, S.M.'86, is working for Academic Press in Cambridge as editor for physics and related fields.

**Richard M. Spitzberg**, Ph.D'73, reports that he has been promoted to senior staff at Lincoln Laboratory. Spitzberg also notes that he and his wife Judy are expecting their third child this summer.

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## X CHEMICAL ENGINEERING

**Ralph Landau**, Sc.D./41, is co-editor (with Professor Dale W. Jorgensen of Harvard Business School) of *Technology and Economic Policy* (Ballinger, 1988), a collection of essays on the effect on technological progress of such economic policies as tax and budgetary reforms. Landau is now affiliated with Stanford, the University of Pennsylvania, and Harvard, and most of these essays were first given as papers at a National Academy of Sciences conference in Washington in 1985.

**Joseph G. Richardson**, S.M./48, partner in Richardson, Sangree and Snider, Houston, was elected to the National Academy of Engineering early this year; he was cited for work in oil recovery and reservoir engineering technologies. . . . **Martin L. Yarmush**, Lucille P. Markey Scholar in the department at M.I.T., was named a 1988 Presidential Young Investigator late last spring; he'll benefit from substantial research funding for the next five years of the award.

**George O.G. Lof**, Sc.D./40, professor of civil engineering and interim director of the Solar Energy Applications Laboratory at Colorado State University, Fort Collins, has been named a fellow of the American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. Lof is a pioneer in the fields of solar energy conversion, heat transfer, water technology, and environmental engineering. . . . **John D. Ireland**, S.M./47, writes from Columbus, Ohio, that he is a State of Ohio energy auditor responsible for audits for state funding of schools and hospitals. "Also continuing some engineering consulting," he writes, "but seem to be slowing down at the office, with a counteracting speed-up on the golf course!"

**David B. Sudikoff**, S.M./78, writes: "Married, living in wonderfully crazy Berkeley, Calif. I am working as senior staff engineer for Measurex, Inc. . . . **William S. Hutchinson, Jr.**, S.M./49, writes from Jacksonville, Fla.: "I hope M.I.T. still has an ROTC program. This past May I joined the other veterans of the 83rd Chemical Mortar Battalion in Baltimore for our 18th reunion since World War II. . . . We won three Presidential Unit Citations . . . lost a host of good men . . . but made the world a little better."

**James R. Katzer**, Ph.D./70, has been promoted to manager, Process Research and Technical Service Division, Mobil Research and Development Corp., Paulsboro, N.J. . . . **Mark Manton**, Ph.D./86, writes from Amsterdam: "I have been working at the Royal Dutch/Shell's Corporate Research Laboratory here for the last 18 months, but even after that long when the going gets tough, this person lapses back into English. Doing research on residue hydroconversion. Before coming here I couldn't believe the statistic that rain falls about 270 days of the year; now I do." . . . **Cary J. King III**, Sc.D./60, writes that since July 1987 he has been provost for the professional schools and colleges at the University of California at Berkeley. King is also chair-elect of the Council for Chemical Research and a director of AIChE.

**Howard Klee, Jr.**, Sc.D./72, writes: "I recently moved to Amoco's Whiting Refinery as a superintendent for major gasoline production facilities. In January 1988 I was appointed an adjunct full professor at the University of Michigan, Ann Arbor. I have been assisting with teaching process design there for the past several years." . . . **Christiaan Lebeer**, S.M./81, became an engagement manager for McKinsey & Co., Cleveland, Ohio.

## XI URBAN STUDIES AND PLANNING

**Francis T. Ventre**, Ph.D./73, who teaches at Virginia Polytechnic Institute and State University, Blacksburg, was among speakers at the opening session last April of the "Facilities 2000" Conference, Grand Valley State University, Allendale,

Mich. The conference topic was "Education and Research Imperatives for Workplaces of the 21st Century," and Ventre's paper was on "Building Issues in a Wider Reference."

**Walter A. Rutes**, '51, founder and chairman of 9 Tek Ltd., Scottsdale, Ariz., development consultants, received the 1988 Platinum Circle Award in Architecture at the 1988 Restaurant and Hotel Industry Design Convention for his outstanding contributions to hotel design. Rutes is well known for his pioneering innovations in all-suite hotel design and authorship of *Hotel Planning and Design*. 9 Tek Ltd. has produced such novel projects as multi-resort communities, leisure parks, and "health-tels."

**Sylvia L. Watts**, M.C.P./83, has been appointed vice-president of development at Taylor Properties, Inc., Boston, responsible for overall management of property acquisitions, design, construction, development, marketing, leasing, and budgets. Before joining the firm in 1986, Watts worked in the Executive Office of Administration and Finance for the Commonwealth of Massachusetts. . . . **Romin Koebel**, Ph.D./73, a planning consultant, has been named a town planner for the city of Hull, Mass. . . . **James A. Forest**, S.M./87, a real estate developer, is a member of the Nashua (N.H.) Affordable Housing Task Force.

**Sarah Rockwell**, M.C.P./85, writes that she is practicing law in a 25-attorney firm in Denver, Colo., concentrating in real estate, land use, and governmental relations. . . . **Eric R. Hansen**, Ph.D./84, writes from Menlo Park, Calif., that he is on leave of absence from the University of Wisconsin, Milwaukee, at SRI International's Center for Economic Competitiveness. His work there includes planning economic development strategies for states and regions including Nebraska, Florida and Karnataka (India), and developing technology policy for Thailand.

**David S. Weinberg**, M.C.P./74, is currently senior vice-president—urban development at Cadillac Fairview Corp., Ltd., Toronto, responsible for acquisition and development of major office and mixed-use projects in Canada. . . . **Luis Dorich**, M.C.P./44, writes from Lima, Peru: "After collaborating for many years with national organizations in Peru connected to urban development and with international organizations related to health aspects of housing and urbanization, I am at present acting as a private consultant in my specialty. I also edit the technical magazine *Plaza Mayor*, mainly related to urban and regional planning and housing."

**Beatrice E. Lewis**, Ph.D./85, reports from West Newton, Mass., of her latest activities: "I'm lecturing on making parks accessible for people with disabilities; writing articles based on my dissertation and undertaking a social impact assessment on transportation alternatives to South Boston with a Boston planning firm; volunteering in my city on collection of hazardous waste in residents' homes; doing public relations activities for my husband's panoramic photography business; and creating heirloom quilts for our children." No wonder she was recently selected as one of Boston's 100 Interesting Women by *Boston Woman* magazine. . . . **Nathan S. Betnun**, Ph.D./75, is manager of public finance for the Washington, D.C., investment banking firm, Ferris & Co.

## XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

**Thomas H. Jordan**, the Robert R. Shrock Professor at M.I.T. since 1984, is head of the department effective July 1. He succeeds **William F. Brace**, Ph.D./53, who has returned to full-time teaching and research after eight years as department head. Jordan is a physical geologist who has made important contributions to tectonics and structural geology. Before coming to M.I.T., he held faculty posts at Princeton and Scripps; his degrees are from Caltech.

**Frederic Shackley II**, '42, writes from Arlington Heights, Ill., that he retired from United Airlines (Meteorology Department) on February 28, 1987. "After a 34-year trial period, I found I couldn't get used to the rotating shifts," says Shackley.

**Bruce J. Brownawell**, Ph.D./86, is continuing research on the topic of his doctoral thesis in the Chemistry Department and Coastal Research Center at Woods Hole Oceanographic Institution. The goal of the program, in which he is associated with John W. Farrington of WHOI, is to develop predictive capability for the short- and long-term fate of synthetic organics and hydrocarbons in marine ecosystems.

Viewers of the 1988 Winter Olympics heard and saw a lot of Alberta's Mount Allan, site of the major skiing events. But few if any knew that Mount Allan was named to honor the late **John A. Allan**, Ph.D./12. Allan founded the Geology Department at the University of Alberta, where he taught from 1912 to 1949, and he is credited with the first geological map of the province, produced in 1925. All this came to M.I.T.'s attention thanks to a call from Allan's son, **John D. Allan**, Ph.D./48, who is now retired and living in Alberta after a geological career with Chevron Oil in western Canada.

Ted Bowell, staff astronomer at Lowell Observatory, Flagstaff, Ariz., has named three newly confirmed asteroids in honor of members of the M.I.T. community: Assistant Professor **Jack Wisdom** of M.I.T., cited for his work on asteroid dynamics; **Linda M. French**, instructor in the department at M.I.T., who has encouraged hands-on astronomy by undergraduates; and **Faith M. Vilas**, S.M./75, astronomer at the Johnsons Manned Space Center, Houston, for her studies of outer-belt minor planets. . . . Another honor, too, for Wisdom; he is one of eight members of the M.I.T. faculty to receive 1988 Presidential Young Investigator Awards administered by the National Science Foundation. NSF will provide a base grant of \$25,000 to support Wisdom's research over the next five years, and industrial grants may substantially increase the funding.

Alumni on the Florida southeast coast were treated to a first-person account of hurricane research by **Robert W. Burpee**, Ph.D./71, of NOAA's Hurricane Research Division. Burpee spoke at a meeting of the M.I.T. Club of Palm Beach County on April 12.

**Andre J. Kermabon**, S.M./56, reports from Marseille: "In 1974, I created Syminex, a high-technology company in Marseilles, France, with subsidiaries in Great Britain and Norway. Initially, most of our work was concentrated in the field of platform dynamics, essentially for the measurement of platform behavior in the North Sea. Syminex is now involved in real-time data acquisition systems applied to civilian and defense industries. Recently the firm was awarded the Prize for International Promotion of Technology by the Institute International de Promotion et de Prestige, a non-governmental organization affiliated to UNESCO. Many of our systems are equipped with Masscomp computers developed in the Boston area. I have an Austrian wife and two children—Christophe, 21 years old who is doing engineering studies, and Michaela, who is a secretary at Syminex."

**Lee-Lueng Fu**, Ph.D./80, reports: "As a technical group supervisor at the Caltech Jet Propulsion Laboratory, I am conducting research work using satellite instruments to study ocean currents and winds." . . . **John T. Distefano**, S.M./83, writes from Cambridge: "I'm a meteorologist working with Lincoln Laboratory on a weather radar program that will help detect low-level wind shear events that are hazardous to aviation."

## XIII OCEAN ENGINEERING

With funds from the M.I.T. Center for International Studies' Japan Endowment, Professor **Ernst G. Frankel**, S.M./60, will pursue research on a



novel proposal: reduce the cost of fueling cargo vessels by storing oil and coal supplies offshore on artificial islands.

To Captain **Barrick F. Tibbitts**, U.S.N., N.E.'65, professor of naval construction and engineering at M.I.T., the President's Legion of Merit Award for "exceptionally meritorious conduct in the performance of outstanding service" in his assignment as director of the Ship Design Group, Naval Sea Systems Command, Washington, from 1984 to 1987.

**Sukeyuki Kobayashi**, Ph.D.'81, reports from Ellicott City, Md.: "I am involved in a research and development project for a new type of propulsor to be used on a small landing craft. As may have always been the case, coming up with a good prototype is a very challenging job." . . . **John M. Camperman**, S.M.'78, of Panama City, Fla., is a life support systems analyst, involved in diving equipment design for the Naval Coastal Systems Center.

**Harry E. Davis**, S.M.'42, reports that he is retired and lives in Lake Placid, N.Y., and Petit Etang, Nova Scotia, Canada. . . . **Thomas F. Donnelly, Jr.**, N.E.'66, is currently president of "Sixth Sense," a community-supported non-profit organization based in the Sixth Congressional District of Washington, working for "peace with justice." . . . **Dimitri Daskalopoulos**, S.M.'84, writes: "I work for a ship finance subsidiary of Greyhound Financial Services Corp., based in Piraeus, Greece. I enjoy a multitude of tasks, having both technical and financial problems to work on." . . . **Webster L. Benham III**, S.M.'77, was recently appointed chief operating officer for the Benham Group, a 460-person architectural and engineering design firm which specializes in design of R&D laboratories, hospitals, and corporate office/computer facilities. Benham lives in Edmond, Okla.

**Pablo J. More**, S.M.'46, of Montevideo, Uruguay, passed away on August 14, 1985. Graciela More Bascou, More's daughter, writes: "Our father very highly valued his stay at M.I.T. and was always saying that he would like one of his grandchildren to study there." Details of his career are not available.

## XIV ECONOMICS

Three members of the M.I.T. community are among the principal staff of the public-interest research and consulting organization, Energy Systems Research Group, Inc., Boston, founded in 1977: **Bruce Biewald**, '81 (IV), whose specialty is modeling power supply system operations; **J. Richard Hornby**, S.M.'79, energy policy analyst who was formerly head of the Energy Office of Nova Scotia; and **David A. Nichols**, Ph.D.'68 (XVII), specialist in energy conservation.

Associate Professor **James M. Poterba** of M.I.T. has received a \$25,000 Alfred P. Sloan research fellowship for 1988. The grant from the Sloan Foundation is to be used by the recipient "to advance (his) research in whatever way (he) thinks best."

**James Guest**, '64, who spent one year as a graduate student at M.I.T. before entering Harvard Law School, is taking aim at Vermont's one seat in the U.S. House of Representatives. He's one of four candidates for the Democratic nomination in Vermont's September 3 primary. In front of a poster proclaiming his campaign slogan, "Keeping Vermont . . . Vermont," Guest announced elements of his platform: universal health care, affordable housing, nuclear arms control, environmental protection, and control of the federal deficit. Guest has been for three years Vermont's banking and insurance commissioner, for two years secretary of state, and for two years development secretary. A resident of Burlington, where he practices law, Guest is president of Consumer's Union, publisher of *Consumer Reports* magazine.

**George C. Galster**, Ph.D.'74, of Wooster, Ohio,



Last month we reported that **Gordon C. Shaw**, S.M.'60, is president of the **Muskoka Lakes Navigation and Hotel Co., Ltd.**, whose major enterprise is operating the **R.M.S. Segwun** on the Muskoka Lakes 100 miles north of Toronto.

The picture says it almost all: **Segwun** is the proud product of 12 years' restoration work and \$1.3 million invested by Shaw and his "steam-buff" friends between 1969 and 1981. In addition to regular trips for tourists, **Segwun** earns her keep as a popular site for wedding receptions, anniversaries, and other special events, and some 5,000 people came to celebrate her 100th birthday in 1987.

**Segwun's** technology is of special interest: she has a 90-horsepower steam-powered generator, and a hand-fired coal-burning boiler powers two reciprocating steam engines. (When not serving on **Segwun's** management, Shaw teaches on the Faculty of Administrative Studies, York University, Toronto.)

had two books published during the fall of 1987; he is the author of *Homeowners and Neighborhood Reinvestment* (Duke University Press) and co-author of *Dynamics of Neighborhood Change and Decline* (Pergamon Press). . . . **Frank C. Colcord, Jr.**, Ph.D.'64, writes: "As of July 1, 1987, I stepped out of my job as Dean of Arts and Sciences at Tufts—a post I held for seven years. I was on sabbatical leave for the 1987-88 academic year—in Paris for the fall term (at the Institut d'Urbanisme de Paris) and at Harvard's Center for International Affairs for the spring term. In the fall of 1988, I will return to full-time teaching."

## XV MANAGEMENT

Innovation happens anywhere and everywhere, says M.I.T. Professor **Eric A. von Hippel**, S.M.'68, in a new book *The Sources of Innovation* (New York: Oxford University Press, 1988). Von Hippel's research on which the book is based shows that innovation typically occurs in different places in different industries and provides a framework for predicting where useful developments are likely to appear.

**Wilbur G. Lewellen**, Ph.D.'67, formerly Loeb Professor of Management (since 1983) in the Krannert School at Purdue, has been named the Kerman Krannert Professor of Management. His teaching and research are in corporate finance, investment management, and international business. . . . **Ronald J. Zlatoper**, S.M.'75, was recently selected for promotion to rear admiral by the Navy's Flag Officer Selection Board. Zlatoper is currently serving as chief of staff for commander U.S. Seventh Fleet aboard the flagship *Blue Ridge* (LCC-19) operating from Yokosuka, Japan. Zlatoper calls the promotion "a real dream come true!" . . . **Michel Simonnard**, S.M.'59, has been named president and chief executive officer of Pechiney Corp., the parent company for the North American activities of the Pechiney Group, Paris. Simonnard joined Pechiney in 1966 and has held several managerial positions.

**Harold K. Agar**, S.M.'54, has left his 40-year

career as an executive in the aerospace industry to join his family business of Southgate Motors, Pittsfield, Mass. The firm has 16 employees and is the Central Berkshire dealer for General Motors trucks. Agar served most recently as president of Plessey Dynamics, Inc., Whippany, N.J. . . . **Keneth A. Isaacs**, S.M.'75, is currently senior vice-president—Construction Group at Perini Corp., Framingham, Mass. Isaacs formerly served as Perini's treasurer. . . . **Edmund A. Hartsook**, S.M.'48, writes from San Rafael, Calif.: "Retired now—spending winter teaching anthropology and geology at the California Academy of Sciences, during the summers the same with the National Park Service. Travel and a variety of philanthropies take up the slack. Fun—and, of course, all volunteer." . . . **John D. Raney**, S.M.'65, assistant administrator at Straub Clinic and Hospital, Inc., Honolulu, is presently chairman of the Statewide Advisory Committee of the Hawaii Coastal Zone Management Program.

**James M. Lattin**, Ph.D.'84, writes from Los Altos, Calif.: "I spent six weeks in Australia on sabbatical leave from Stanford Business School. **John Roberts**, Ph.D.'84, who is associate professor at the Australian Graduate School in Sydney, hosted my stay as a visiting faculty member at the school." . . . From **Fernando Menendez Legorburu**, S.M.'85, in Bilbao, Spain: "At present I am working for Bankers Trust Co. as a financial analyst in mergers, acquisitions and leveraged buyouts. These are two very new activities in Spain, and as such very exciting. Since we are a small group, we in fact do everything from marketing, market research, and analyzing companies' reports to formal financial analysis. I work and live in Madrid." . . . **Charles C. Holcomb**, S.M.'75, is currently director of South Carolina operations for Arthur D. Little Program Systems Management Co. in Charleston.

**John W. Cuming**, S.M.'84, is working as a business manager for Cuming Corp., Taunton, Mass., a small family-owned business specializing in materials for radar cross section reduction. . . . **Suellen Fausel**, S.M.'86, reports from Bay City, Mich.: "I played Florence Unger in Neil Simon's female version of 'The Odd Couple' at Pit & Bal-



cony Theatre in Saginaw, Mich. I am currently program implementation manager for future new car programs for General Motors' Flint Automotive Division.

**Arnold O. Putnam**, S.M.'47, chairman emeritus and member of the Board of Directors of Rath & Strong, management consultants, Lexington, Mass., passed away on February 4, 1988, in Matapoisett, Mass. Putnam joined Rath & Strong in 1951 and served as its president and chief executive officer from 1967 until 1986. He was a past vice-president and director of the Association of Consulting Management Engineers, New York; former president and founding member of the Institute of Management Consultants, New York; widely known as a management consultant; and author of articles and books in the field of management information systems. Serving in the army in Europe during World War II, Putnam rose to the rank of captain and received the Bronze Star. . . . **Edward M. Peacock**, S.M.'47, passed away on December 11, 1987, in Islington, Ontario. In a note to the Alumni Association, Peacock's wife, Margaret, notes: "Graduating from M.I.T. was one of Ed's most satisfying accomplishments." No further details are available.

## Sloan Fellows

**Robert E. McKee**, S.M.'83, has been named general manager of the Engineering and Research Department at Conoco, Inc., Houston. McKee joined Conoco in 1986 and most recently served as general manager for the company's domestic onshore production. . . . **Armen Der Marderosian**, S.M.'75, is currently group vice-president and general manager for tactical systems at GTE Government Systems Corp., Taunton, Mass. . . . **George W. Morgenthaler**, S.M.'70, professor and chairman of aerospace engineering sciences and associate dean of engineering at the University of Colorado, Boulder, has a major responsibility as the manager of the state of Colorado's proposal for the superconducting supercollider project.

Two deaths have been reported to the Alumni Association, with no further details available: **Eduardo E. Richards**, S.M.'84, of Buenos Aires, Argentina, on November 16, 1987; and **Andrew E. Burnett**, S.M.'41, of Birmingham, Ala., on December 15, 1987.

## Senior Executives

A major honor for **Donald E. Procknow**, '63, retired vice-chairman of AT&T Technologies, Inc.: election late this spring to the National Academy

of Engineering. Procknow was cited for "outstanding leadership of a premier telecommunications manufacturing institution."

**John O'Brien**, '66, formerly president and chief operating officer at Grumman Corp., Bethpage, N.Y., is now president and CEO and in addition will become chairman of the board this August. . . . **Barron W. Schoder, Jr.**, '78, has been named president of the Information Services Group at R.R. Donnelley & Sons Co., Chicago, Ill. Schoder was formerly senior vice-president of the firm's General & Directory Sales Unit.

**J. Carl Ferguson**, '63, of Hughson, Calif., passed away on October 26, 1987; no further details are available.

## Management of Technology Program

**Charles R. Bow**, S.M.'84, is marketing manager for Schlumberger Industries, Felixstowe, England. . . . **David C. Hite**, S.M.'84, is member of the Technical Staff, Civil Systems Division of the Mitre Corp., McLean, Va. . . . **Richard Norton**, S.M.'85, has been working as project manager for J.P. Kapp & Associates, Tustin, Calif., since October 1987. He is responsible for a major planned community project and largest city jail in the United States. Children Samantha (age 5) and Alexandra (age 2) are doing very well. His wife Karen has had many visitors from the Boston area, so they have been kept up to date.

**Glenn Nedwin**, S.M.'87, has recently moved to Ideon Corp. as vice-president—business development. Glenn says that it is a great opportunity for him to do what he went to school for—to start up a science/technology-based company. Glenn and his wife, Julie, are proud parents of three beautiful daughters (identical triplets!). The girls, Alexandra Michelle, Elise Nicole, and Lindsay Jaclyn, were born January 10, 1988. . . . **Karen Simms**, S.M.'87, is manager of technology transfer at Anigenics, Inc., Cambridge.—Cheryl Kelliher, Management of Technology Program, M.I.T., Room E52-125, Cambridge, MA 02139

## XVI AERONAUTICS AND ASTRONAUTICS

As a member of the technical staff at Alphatech, Inc., Burlington, Mass., **Thomas G. Allen**, S.M.'84, is working on computer algorithms for simultaneously tracking many different orbital objects—a problem inspired by SDI scenarios. The only solution, he says, is the immense computing power made possible by parallel processing, and he described his work with hypercube computers for members of the Control Systems Chapter, IEEE Boston Section, late last spring. . . . Late in the winter, **Jerold L. Weiss**, S.M.'83, also of Alphatech, Inc., had described for the Control Systems Chapter his work on concepts for restructurable flight controls—systems that would help pilots deal with emergencies created by failures in control systems.

A new book on non-equilibrium power generation will result from collaboration between M.I.T. Professor **Jean F. Louis** and Professor S. Shoda of the Tokyo Institute of Technology, made possible by a grant from the Japan Endowment Fund of the M.I.T. Center for International Studies.

**Theodore H. Pian**, Sc.D.'48, professor of aeronautics and astronautics at M.I.T., was elected to the National Academy of Engineering late this spring; he was cited for "his contributions to hybrid finite element methods for the analysis of structures."

Recalling the investigation of the *Challenger* shuttle disaster at a seminar early this year, Professor **Eugene E. Covert**, Sc.D.'58, of M.I.T., who was a member of the presidential investigating commission, says one simple analysis of available data would have prevented the accident. The commission plotted the amount of charring of the suspect O-rings in all previous shuttle flights against ambient temperature at launch, he said, and the data turned out to be "unassailable"—the

colder the temperature, the more charring. "If the data had been presented in this way, . . . the launch would have been cancelled," he told an M.I.T. seminar. . . . **Jack L. Kerrebrock**, Maclaurin Professor in the department at M.I.T. and associate dean of the School of Engineering, has been made a fellow of the American Association for the Advancement of Science.

**Allan Boardman**, '55, has been named group vice-president, administration, at the Aerospace Corp., Los Angeles. Boardman joined Aerospace in 1962 and most recently served as vice-president, Advanced Orbital Systems Operation, Development Group. . . . **Sam W. Thurman**, S.M.'85, reports that he married Lisa G. Nolan on October 4, 1987. Thurman left Draper Laboratory in October 1987 for a new job at Jet Propulsion Laboratory, Pasadena, as staff engineer in the spacecraft navigation systems area. . . . **Nithiam T. Sivaneri**, S.M.'78, is currently associate professor in the Department of Mechanical and Aerospace Engineering at West Virginia University, Morgantown, conducting research in the areas of helicopters, FEM, BEM, and fracture mechanics.

## XVII POLITICAL SCIENCE

**Joshua S. Goldstein**, Ph.D.'86, assistant professor of international relations at the University of Southern California, is the author of *Long Cycles: Prosperity and War in the Modern Age* (Yale University Press, 1988). It's described as a "pathbreaking interdisciplinary" study of the relationship of long economic cycles to social and political phenomena and of their role in the world system over the past five centuries.

**Avivah Swirsky Litan**, S.M.'79, has recently been promoted to leader of the management information project for the Office of Senior Vice-President for Finance at the World Bank, Washington, D.C. . . . **Nelle W. Temple**, Ph.D.'80, writes from McLean, Va.: "I'm enjoying a worm's eye view of the formation of U.S. development policy toward the Third World as the minority staff of the International Development Institutions Subcommittee of the House Banking Committee. My main observation is that the multilateral nature of current political and economic realities are difficult for Congress to accept."

**Evelyn Z. Brodtkin**, Ph.D.'83, reports that in September 1987 she joined the faculty of the University of Chicago School of Social Service Administration as assistant professor. She is the author of *The False Promise of Administration Reform: Implementing Quality Control in Welfare* (Temple University Press, 1987). . . . **Richard A. Rettig**, Ph.D.'67, writes from Washington, D.C., that in January 1987 he joined the staff of the Institute of Medicine, National Academy of Sciences, as director of the Council on Health Care Technology.

## XVIII MATHEMATICS

To Professor Emeritus **Herman Chernoff** of M.I.T., the 1987 Samuel S. Wilks Memorial Medal of the American Statistical Association. Chernoff was cited "for outstanding research in large sample theory and sequential analysis, extensive service to scholarly societies and on government panels, effectiveness and popularity as a teacher, and continuing impact on the theory of statistics and its applications in diverse disciplines." . . . **Antonio Sanchez-Calle**, assistant professor at M.I.T., has been honored with a \$25,000 Alfred P. Sloan Research Fellowship for 1988. . . . And **Richard M. Dudley**, professor of applied mathematics at M.I.T., has been named a fellow of the American Association for the Advancement of Science.

The honor of election to the National Academy of Engineering came to Professor **Enders A. Robinson**, Ph.D.'54, McMan Professor of geo-

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Robert T. Gammons, '33  
Charles E. Pfund  
Donald Brown  
Robert L. Goldberg  
Robert F. O'Connell, '53  
David G. Conlin  
George W. Neuner, '66  
Phillip G. Koenig  
Robert M. Asher, '78  
Gregory D. Williams  
Ernest V. Linek



physics at Tulsa University, late this spring; he was cited for pioneering contributions in applying semiconductor technology to seismic processing.

## XX APPLIED BIOLOGICAL SCIENCES

For his work on the human utilization of protein and how aging affects this process, Adjunct Professor **Hamish N. Munro** received the Bolton L. Corson Medal of the Franklin Institute, Philadelphia, late last spring. In addition to his teaching at M.I.T., Munro is director of the U.S. Department of Agriculture Human Research Center on Aging at Tufts University.

**Barbara J.S. Greenberg**, S.M.'77, writes from Albany, N.Y.: "I have recently left the field of nutrition to return to statistics and research design as assistant director of the Research and Evaluation Bureau of the New York State Elderly Pharmaceutical Insurance Coverage Program (EPIC). EPIC is a new \$140 million state program designed to provide financial assistance to the elderly in the purchase of prescription drugs. My main responsibility is to develop and implement research projects to evaluate the effectiveness of the program." . . . **Dominick P. DePaola**, Ph.D.'74, writes from Berkeley Heights, N.J., of her recent appointment as dean of the New Jersey Dental School of the University of Medicine and Dentistry of New Jersey, effective last January 1. Previously she had been dean of the Dental School of the University of Texas Health Science Center.

## XXII NUCLEAR ENGINEERING

Professor **Otto K. Harling**, director of the M.I.T. Nuclear Reactor Laboratory, will study Japanese efforts to reduce occupational radiation exposure among workers at Japanese nuclear reactors under a grant from the Japan Endowment Fund of the M.I.T. Center for International Studies.

Six members of the M.I.T. community are working with the Department of Energy on panels to evaluate sites and technologies for a planned new production reactor to produce nuclear weapons materials: **Lawrence T. Papay**, Sc.D.'69, senior vice-president of Southern California Edison Co.; **Frederick W. Buckman**, Ph.D.'70, senior vice-president—energy supply of Consumers Power Corp., Jackson, Mich.; **Joseph G. Gavin, Jr.**, '41, retired president of Grumman Corp., Bethpage, N.Y.; **Louis Roddis**, S.M.'44, consulting engineer of Charleston, S.C.; **Lombard Squires**, '31, consultant of Naples, Fla.; and **Neil E. Todreas**, Sc.D.'66, head of the M.I.T. Department of Nuclear Engineering. . . . **Joseph Sasson**, S.M.'85, writes from Antony, France: "I am working on graphic seismic interpretation software for the major geo-physical company in France, Compagnie Generale de Geophysique. It is developed on H-P 9000 and also on the Micro Vax with graphic monitors made in Boston by Raster Technologies. God, how I miss Cambridge and M.I.T.!"

**J. L. Del Valle Doblado**, S.M.'78, writes from Madrid, Spain: "After selling the bank's holdings in Andaluza de Piratas S.A., the company I have managed for the last 7+ years, I have rejoined Banco Central S.A. as subdirector general in charge of the investment banking activities."

## TECHNOLOGY AND POLICY PROGRAM

**Dana Mukamel**, S.M.'77, is currently working in health care policy for the Rochester Area Hospitals Corp. in New York. . . . **Dave Summa**, S.M.'85, has recently moved from product development to corporate planning at Procter and Gamble, Cincinnati. . . . **Marina Pocater**, S.M.'87, travels overseas as a senior consultant with Deloitte, Haskins & Sells, Washington, D.C.—Richard de Neufville, Chairman, M.I.T., Room 1-138, Cambridge, MA 02139



*The flag displayed by Professor Eugene E. Covert, Sc.D.'58, head of the Department of Aeronautics and Astronautics, is special. It was carried by astronaut David R. Scott, E.A.A.'62, on an extensive geological traverse across the surface of the moon during the Apollo 15*

*mission in 1971. Upon the return of the mission Scott gave the flag to his daughter Tracy, and now she has decided that it should be at M.I.T. The Institute is honored, says Covert, and the flag will be prominently displayed in Building 33.*



*Who would buy this 1988 Pontiac LeMans? General Motors asked teams of marketing students from 10 U.S. and Canadian universities how to market and advertise the car. Prize money of \$30,000 was divided among three schools—among them the Sloan School*

*of Management—whose teams wrote what GM considered the best comprehensive marketing plans. In the picture, Sloan's team is shown with faculty advisor David A. Weber, S.M.'83, associate director of the Master's Program.*



**Walter J. Beadle, 1896-1988**

**W**alter J. Beadle, '17, who was a major figure in the Du Pont company and at the time of his death the most senior member of the M.I.T. Corporation, died on February 8 at his home in Kennett Square, Pa.; he was 92.

Beadle entered M.I.T. in 1913, but he interrupted his studies to serve in the army during World War I; he finally took his bachelor's degree in mechanical engineering in June 1920. Meanwhile, he had participated in the Meuse-Argonne offensive in 1918 and remained in Europe for many months with the army of occupation.

Beginning in 1928, Beadle's first assignment for E. I. du Pont de Nemours and Co. was as a financial analyst. By 1946 he was vice-president and treasurer of the company and a member of its Board of Directors, and eight years later he was made a member of its Executive Committee. Meanwhile, he was elected to the M.I.T. Corporation as an alumni nominee in 1943, becoming a life member in 1951 and life member emeritus in 1966. Beadle held important assignments in the Philadelphia area for the M.I.T. Alumni Association as well as many civic organizations. □

**Paul M. Fye, 1913-1988:  
Leader in Oceanography**

**P**aul M. Fye, who was director of the Woods Hole Oceanographic Institution for 20 years beginning in 1958, died in Falmouth, Mass., on March 11; he was 75.

Fye's career in oceanography spanned 50 years following graduation from Albright College, Reading, Pa. He first went to WHOI in 1942, and in the 20 years of his leadership the institution's budget increased 12-fold. He was a principal architect of the joint WHOI-M.I.T. graduate program which has awarded more than 200 doctoral degrees in marine sciences since 1958. Fye awarded many of these as a participant in M.I.T. commencements. □

**C. Gardner Swain, 1918-1988:  
Specialist in Chemical Reactions**

**A** 40-year career in chemistry at M.I.T. ended on March 10 with the death of Professor Emeritus C. Gardner Swain, who had retired from active teaching in 1986. He was 70, and his death due to cancer followed a short illness.

Swain came to M.I.T. to hold an American Chemical Society fellowship in 1946; he was an instructor in 1947 and 1948 before being invited to join the faculty, and

he was promoted to the rank of professor in 1958.

Swain made major contributions to the understanding of many chemical reactions, and through his teaching influenced many generations of M.I.T. students, including 64 doctoral recipients. He taught the undergraduate course in physical chemistry (5.54) for 24 years, giving special emphasis to quantitative relationships and (as early as the 1960s) the potential role of computers. Among graduate students he was noted for encouraging unusually free intellectual debate.

Before coming to M.I.T., Swain had graduated from Thayer Academy and Harvard, where he received both bachelor's (1940) and Ph.D. (1944) degrees, and he spent 1944-45 as a postdoctoral fellow with Professor Linus Pauling at Caltech. Among Swain's honors were a Guggenheim Fellowship for work in England in 1954-55, the 1957 American Chemical Society Award in Petroleum Chemistry, and a 1961 lectureship of the American Swiss Foundation for Scientific Exchange. □

**George G. Harvey, 1908-1988**

**P**rofessor Emeritus George C. Harvey, who for many years was executive officer of the Department of Physics and associate director of the Research Laboratory of Electronics, died on April 9 in Cambridge; he was 80.

In addition to his administrative work, Harvey was known for studies on x-ray scattering and atomic structure and for developments in electron microscopy. As a member of the Radiation Laboratory during World War II, he developed radio and radar antennas with novel properties—work that won for him a certificate of appreciation from the Office of Scientific Research and Development.

Harvey first came to M.I.T. as instructor in physics in 1934, following study at Washington University (St. Louis) for bachelor's (1928), master's (1930), and doctor's (1932) degrees in physics. He joined the M.I.T. faculty in 1938 following a year as instructor at the City College of New York, and he was promoted to associate professor in 1943 and professor in 1961. He retired in 1973. □

**Deceased**

The following deaths have been reported to the Alumni Association since the *Review's* last deadline:

Mrs. Alfred L. Coupe, '04; 1965.  
Luke E. Sawyer, '10; 1969.  
Mrs. J. Burleigh Cheney, '11; 1955.  
Mrs. Robert H. Mather, '11; 1961.  
Mrs. Henry H. Thompson, '13; September 7, 1987; Boca Raton, Fla.

C(harles) Ellis Ellicott, Jr., '15; January 28, 1988; Baltimore, Md.  
Joel I. Connolly, '16; January 1988; Tucson, Ariz.  
Frederick S. Kenney, '16; February 10, 1988; Templeton, Mass.  
John G. Lee, '21; April 7, 1988; Mystic, Conn.  
James S. Parsons, '21; February 12, 1988; High Point, N.C.  
Robert T. Armstrong, '23; September 23, 1985; Dedham, Mass.  
Frank T. Bunting, '23; December 17, 1986; Cumberland, R.I.  
Nicholas Kane, '23; December 5, 1977; Tamarac, Fla.  
Paul L. Sharkey, '24; February 10, 1988; San Antonio, Tex.  
Stanley H. Turner, '24; October 1987; Harvard, Mass.  
Willard W. Van Allen, '24; November 27, 1987; E. Boothbay, Maine.  
Winthrop L. Warner, '24; November 25, 1987; Vero Beach, Fla.  
Michael S. Lespasio, '25; March 31, 1988; Revere, Mass.  
Theodore F. Flimpton, '25; March 18, 1988; Albuquerque, N.Mex.  
Arthur M. Worthington, Jr., '25; September 18, 1987; Methuen, Mass.  
Peter B. Loomis III, '26; August 31, 1987; Simsbury, Conn.  
George Allan Holderness, Jr., '28; April 17, 1987; Chevy Chase, Md.  
William P. Rothwell, '28; January 28, 1988; Center Ossipee, N.H.  
William J. Sweeney, '28; March 30, 1988; Summit, N.J.  
Thomas H. Coe, Jr., '29; March 4, 1988; Howey in The Hills, Fla.  
Frederic D. Merrill, Jr., '29; January 14, 1988; Chatham, N.J.  
Edgar M. Hawkins, Jr., '30; November 27, 1987; Petersburg, Va.  
Julian P. Hastings, '31; September 28, 1987; Framingham, Mass.  
Theodore C. Morrill, '31; September 1987; Amherst, Mass.  
Charles O. Terwilliger, Jr., '31; February 17, 1988; Laramie, Wyo.  
Howard J. Wood, '31; March 14, 1988; Louisville, Ky.  
Winston B. Braxton, '32; July 27, 1987; Syracuse, N.Y.  
Donald B. Gilman, '32; December 14, 1987; Peterborough, N.H.  
George Goodman, '32; January 1, 1988; Belmont, Mass.  
W(illiam) Penn-Gaskell Hall, Jr., '32; August 29, 1987; Cochranville, Penn.  
Thomas B. Rhines, '32; March 5, 1988; Hancock, N.H.  
Frederick Carlyle Roberts, Jr., '32; April 28, 1987; Pasadena, Calif.  
Winthrop W. Adams, '33; December 29, 1987; Boston, Mass.  
Joseph M. Dailey, '33; May 5, 1987; Quincy, Mass.  
Pierre S. du Pont, '33; April 9, 1988; Wilmington, Del.  
Joseph A. Murphy, '33; August 10, 1985; Johnston, R.I.  
William W. Bentley, Jr., '34; April 5, 1988; San Diego, Calif.  
William W. Buttmi, '34; December 17, 1987; Saint Petersburg, Fla.  
John B. Dunning, '34; November 4, 1987.  
Kendal C. Ham, '34; March 12, 1988.  
Lee J. Rusling, '34; February 22, 1988; Rochester, N.Y.  
Carson L. Brooks, '35; August 26, 1987; Phoenix, Ariz.  
Walter P. Green, '35; September 14, 1987; E. Providence, R.I.



**Dorothy D. Thompson**, '35; February 19, 1988; Jamaica Plain, Mass.  
**Edward L. Pratt**, '36; March 30, 1988; Cincinnati, Ohio.  
**Harry A. Raddin**, '36; December 6, 1987; Richmond, Va.  
**Ladislav Reday**, '36; August 25, 1987; Newport Beach, Calif.  
**John G. Stapler**, '36; February 23, 1988; Bowdoinham, Maine.  
**James C. Agnew**, '37; February 18, 1988; Brattleboro, Vt.  
**Charles W. Matthews**, '37; March 29, 1988; Cincinnati, Ohio.  
**Abraham Fineman**, '38; January 14, 1988; South Wellfleet, Mass.  
**John A. Hilcken**, '38; January 24, 1988; Richmond, Va.  
**David E. Irving**, '38; March 23, 1988; Gladwyne, Penn.  
**William H.S. Preece**, '38; December 15, 1987; Highland Park, Ill.  
**Richard P. Feynman**, '39; February 15, 1988; Altadena, Calif.  
**Walter A. Wachter**, '39; November 9, 1987; Naples, Fla.  
**C. Gordon Livingston**, '40; February 14, 1988; Rancho Palos Verdes, Calif.  
**Louis V. Russoniello**, '40; January 7, 1988; Dunmore, Penn.  
**Kendall C. Valentine**, '40; April 2, 1988; South Glastonbury, Conn.  
**Richard E. Ball**, '41; January 13, 1988; Coronado, Calif.  
**Andrew E. Burnett**, '41; December 15, 1987; Birmingham, Ala.  
**Walter E. Carran, Jr.**, '41; October 30, 1987; Hingham, Mass.  
**Michael Driscoll II**, '41; January 18, 1988; Nantucket Island, Mass.  
**David L. Hixon**, '41; January 5, 1988; Utuado, P.R.  
**Gideon Hofmann**, '42; June 12, 1987; Pasadena, Calif.  
**Albert S. Knight, Jr.**, '42; November 6, 1986; Canandaigua, N.Y.  
**Charles M. Clapp**, '43; February 4, 1988; Massillon, Ohio.  
**Sidney L. Hall**, '43; November 17, 1987; Brookline, N.H.  
**William H. Peiler**, '43; September 1, 1987; Kingwood, Tex.  
**Carroll W. Boyce**, '44; December 10, 1987; Fort Myers, Fla.  
**Bruce A. Lamberton**, '44; March 9, 1988; Strongsville, Ohio.  
**Herschel A. Elarth**, '46; January 19, 1988; Blacksburg, Va.  
**Pablo J. More**, '46; August 14, 1985; Montevideo, Uruguay.  
**Charles Chia-Lai Weng**, '46; January 1987; New York, N.Y.  
**James W. Fitzwilliam**, '46; January 15, 1988; Summit, N.J.  
**Edward M. Peacock**, '47; December 11, 1987; Islington, Canada.  
**Arnold O. Putnam**, '47; February 4, 1988; Mattapoisett, Mass.  
**W. Stewart Brauns, Jr.**, '48; September 29, 1987; New York, N.Y.  
**Lewis D. Etherington**, '49; November 14, 1987; San Diego, Calif.  
**William B. Richards**, '49; July 12, 1987; Santa Rosa, Calif.  
**Samuel Rosenfield**, '49; July 1986; Lexington, Mass.  
**Richard C. Granke**, '50; November 11, 1987; Silver Spring, Md.  
**Warren W. Lee**, '50; January 12, 1988; West Simsbury, Conn.  
**James H. McMahon**, '50; December 21, 1987; Ridgecrest, Calif.  
**William W. Newitt**, '50; January 26, 1988; Galien,

Mich.  
**Andrew J. Bowen**, '57; 1986; Merrimack, N.H.  
**James J. Coles**, '57; October 24, 1987; Bridgeport, Conn.  
**Murray Muraskin**, '57; 1985; Forest Hills, N.Y.  
**Hugo F. Schieck, Jr.**, '60; 1987; Rio de Janeiro, Brazil.  
**J. Carl Ferguson**, '63; October 26, 1987; Hughson, Calif.  
**Jack H. Pursel**, '68; 1985; Chatham, N.J.  
**Bernard H. Gwynn**, '70; December 8, 1986; Edinboro, Penn.  
**John H. Stacha**, '72; 1986.  
**Daniel J. Knighton**, '73; September 1985; Baltimore, Md.  
**Joseph A. Merrigan**, '74; March 20, 1988; Webster, N.Y.  
**James R. Sylla**, '77; December 7, 1987; Kentfield, Calif.  
**Eduardo E. Richards**, '84; November 16, 1987; Buenos Aires, Argentina.  
**Louise M. Sedlacek**, '87; April 7, 1988; Darien, Ill.  
**Mark R. Kordos**, '89; April 8, 1988; Cambridge, Mass.

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Of Counsel  
 Alfred R. Johnson, '35  
 Joseph Zallen, '39



## Palindromes and a Naymandidge

Since it has been a year since I reviewed the criteria used to select solutions for publication, let me do so now.

As responses to problems arrive, they are simply put together in neat piles, with no regard to their date of arrival or postmark. When it is time for me to write the column in which solutions are to appear, I first weed out erroneous and illegible responses. For difficult problems, this may be enough; the most publishable solution becomes obvious. Usually, however, many responses still remain. I next try to select a solution that supplies an appropriate amount of detail and that includes a minimal number of characters that are hard to set in type. A particularly elegant solution is, of course, preferred. I favor contributions from correspondents whose solutions have not previously appeared, as well as solutions that are neatly written or typed, since these produce fewer typesetting errors.

Electronic mail can be sent to me using the internet address gottlieb@nyu.edu, and I can format responses with the standard unix tools (troff, eqn, tbl, pic, -me -ms macros).

### Problems

**JUL 1.** We begin with a computer-oriented problem from Matthew Fountain, inspired by Fermat:

Write an efficient computer program for searching for positive integer solutions to the equation

$$x^3 + y^3 + c = z^3$$

and list all values of  $c$  between 0 and 100 for which you find solutions. You will need to bound  $x$  and  $y$  (thereby bounding  $z$ ). Efficiently searching all values less than a few thousand is a modest (but not trivial) computation.

**JUL 2.** The following naymandidge (defined below) is from Neil Macdonald's

puzzle column in the September-October issue of *Computers and People*:

In a naymandidge, an array of random or psuedo-random digits ("produced by nature"), such as that at the bottom of this column, has been subjected to a "definite systematic operation" ("chosen by nature"). The problem ("which man is faced with") is to figure out what was nature's operation. A "definite systematic operation" meets the following requirements: the operation must be performed on all the digits of a definite class which can be designated; the result must display some kind of evident, systematic, rational order and completely remove some kind of randomness; and the operation must be expressible in not more than four English words. (But *man* can use more words to express the solution and still win.)

4 8 0 1 8 9 1 7 5 1 0 4 4 6 2 1 7 4 7 7  
5 1 8 6 4 8 9 1 4 4 3 0 0 4 2 1 0 9 8 7  
9 3 2 9 9 6 5 2 3 5 6 0 5 8 2 2 9 7 5 0  
4 9 6 2 4 8 7 7 5 3 6 4 5 0 7 1 9 7 9 3  
8 0 1 5 0 2 9 4 6 0 9 9 4 3 3 1 1 6 7 0  
8 5 7 8 6 6 2 2 4 6 9 8 7 5 8 1 7 9 2 1  
4 7 4 3 8 7 4 7 6 1 1 5 6 1 4 2 8 4 0 4  
0 5 4 1 7 4 1 5 2 1 1 2 7 0 3 2 2 7 9 3  
6 8 9 9 2 2 9 4 6 7 7 2 4 1 0 1 6 8 6 8  
2 6 6 7 8 0 9 7 6 5 1 7 8 4 3 2 0 1 0 0

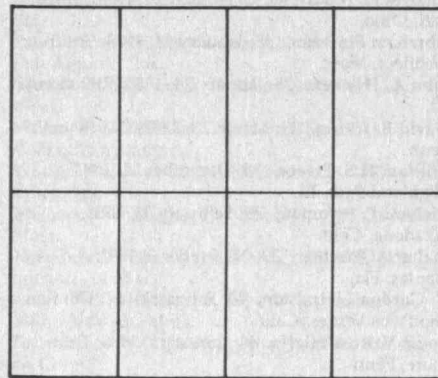
**JUL 3.** Dave Mohr has a pure sinusoidal tone to which he proposes to add a second pure sinusoidal tone of identical amplitude and frequency but with a random phase shift. What is the probability that the resulting sound is lower in volume than the original tone?

**JUL 4.** Frank Rubin is interested in doubly palindromic numbers, i.e. a number  $N$  that is palindromic when expressed in each of two bases  $p$  and  $q$ , where  $\gcd(p, q) = 1$  and  $N$  exceeds the product  $pq$ . Are there any such  $N$ ? If so, is there a largest?

**JUL 5.** Robert Johnson needs help in folding his maps:

Take an  $8\frac{1}{2} \times 11$  inch piece of paper (preferably with writing on both sides) and fold it in half three times, as if you were about to store it into your shirt pocket. Now unfold it. If you are like most of us, the fold lines will separate the paper into two rows of four rectan-

gles all of which are identical:



In how many unique ways can you completely fold up the paper, assuming that you only make flat folds along the fold lines? Now suppose you had a strip of paper containing one row of six rectangles. How many ways can you fold that? What are the odds that the large map inside your automobile glove compartment is correctly folded?

### Speed Department

**SD 1.** Jim Landau recalls that Robert Moeser's solution of 1986 JAN 3, while discussing reciprocals of prime numbers, comes to a conclusion and then says "viola!" Mr. Landau now asks, What relation do musical instruments have to reciprocals of primes?

**SD 2.** On a one-year certificate of deposit, Stephen McAdam's bank pays 8% compounded quarterly, with a 2% bonus during the first quarter (so the rate that quarter is 10%). Another bank also pays 8% compounded quarterly, but they pay the 2% bonus during the last quarter. Which offers the better deal?

### Solutions

**F/M 1.** Define an ordering of  $n!$  permutations of  $n$  objects by considering the objects as the first  $n$  letters of the alphabet and arranging the  $n!$  permutations in alphabetical order. For  $n = 3$  this gives

- |        |        |
|--------|--------|
| 1. ABC | 4. BCA |
| 2. ACB | 5. CAB |
| 3. BAC | 6. CBA |

The  $m$ th permutation is now defined as the permutation that is number  $m$  in alphabetical order. Devise a nonrecursive algorithm and/or write a program which will find the  $m$ th permutation of  $n$  objects. By nonrecursive is meant that the algorithm



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012.



```

with TEXT_10, INTEGER TEXT_10, FACTORIAL;
procedure PERMUTE is
  SET : STRING (1..26) := "ABCDEFGHIJKLMNOPQRSTUVWXYZ";
  M, N, J : INTEGER;
begin
  TEXT_10.PUT ("Enter the number of elements: ");
  INTEGER TEXT_10.GET (N);
  TEXT_10.PUT ("Enter the permutation number: ");
  INTEGER TEXT_10.GET (M);
  for I in 1..N-1 loop
    J := (M * FACTORIAL (N - 1) - 1) / FACTORIAL (N - 1);
    SET (1..I + J - 1) := SET (I + J - 1) & SET (1..I + J - 2);
    M := M - (J - 1) * FACTORIAL (N - 1);
  end loop;
  TEXT_10.PUT_LINE (SET (1..N));
end PERMUTE;

```

can find the  $m$ th permutation without knowing (or computing) the  $(M - 1)$ th or any other permutation.

Stephen Merola writes:

Here is a non-recursive solution. A program, written in ADA under VAX/VMS, is shown at the top of this column. The program iterates from 1 to  $n$  calculating which element of the set belongs in that position. Assuming that we're using the letters of the alphabet, the program starts with a sorted array, e.g. for  $n = 4$  we have ABCD. The  $i$ th element of the final array is the  $j$ th element of the remaining elements where  $j$  is given by:

$$j = \lfloor m/(n-1)! \rfloor$$

Here's some pseudo code:

for  $I = 1$  to  $N = 1$  do

$J = \text{ceiling}(M/(N-I)!)$

$\text{SET}(I..I+J-1) = \text{SET}(I+J-1) \& \text{SET}(I..I+J-2)$

$M = M - (J-1) * (N-I)!$

end do

For initial conditions,  $N = 4$ ,  $\text{SET} = \text{ABCD}$ ,  $M = 6$ :

After iteration 1,  $J = 1$ ,  $N = 3$ ,  $\text{SET} = \text{ABCD}$ ,  $M = 6$

After iteration 2,  $J = 3$ ,  $N = 2$ ,  $\text{SET} = \text{ADBC}$ ,  $M = 2$

After iteration 3,  $J = 2$ ,  $N = 1$ ,  $\text{SET} = \text{ADCB}$ ,  $M = 1$

At the end of this loop, the array of characters, SET, initially sorted, will now be in the order of the  $M$ th permutation.

Also solved by Matthew Fountain, Robert Bart, Roger Spellman, Lorenzo Sadun, Richard King, Richard Hess, Louis Howell, John Chandler, and Steven Feldman.

**FM 2.** Given positive integers  $x$  and  $y$ , find positive integers  $a$ ,  $b$ ,  $c$ , and  $z$  satisfying  $a^x + b^y = c^z$ .

If  $z = 1$ , the problem is trivial: we can choose  $a$  and  $b$  arbitrarily and let  $c = a^x + b^y$ .

Lorenzo Sadun suggests

$a = 2^x$ ,  $b = 2^y$ ,  $c = 2$ ,  $z = xy + 1$ .

Also solved by Matthew Fountain, Ken Rosato, John Chandler, Louis Howell, Richard Hess, Richard King, Robert Bart, and the proposer, Frank Rubin.

**FM 3.** Find the smallest integer  $A$  such that the first ten digits of the square root of  $A$  are distinct.

The following solution is from Louis H. Howell: I didn't see a way to do this analytically, so I made a short program to search for solutions. In less than a second on a Sun3 workstation it found that the number 1362 has 36.9052841744919... as its square root. There are five other solutions less than 10000: 1843, 2540, 4280, 5507, and 6896. I saw no particular pattern to later solutions, except that the solutions tend to be rather bunched up in some intervals, while other large intervals have no solutions at all.

Also solved by Matthew Fountain, Richard Hess, Steven Feldman, John Prussing, Roger Spellman, Robert Bart, and the proposer, Nob Yoshigahara.

**FM 4.** Form palindromes of the type "— was I ere I saw —," where the last word of the sentence is a place name, and where the cleverness of the composition depends on to whom you attribute it. The classic is "able was I ere I saw Elba," attributed to Napoleon.

I am printing all the solutions received for this one, not claiming that I fully understand each one:

Frederick Furland sent two:

Sage v. salt at Las Vegas—Food controversy head-

line

A laconic in Ocala—Calvin Coolidge visits Florida headline

Robert Bart also sent two:

Not so, Ben, was... saw N.E. Boston—Washington to Franklin

No Geronimo or on was... saw no room in Oregon—Crazy Horse to Egyptian archeologist

John Chandler adds:

Nowhere was I ere I saw Erehwon—James Hilbert

Finally, five from the proposer, Solomon Golomb:

A rat was I ere I saw Tara—Rhett Butler

Zeus was I ere I saw Suez—Nasser

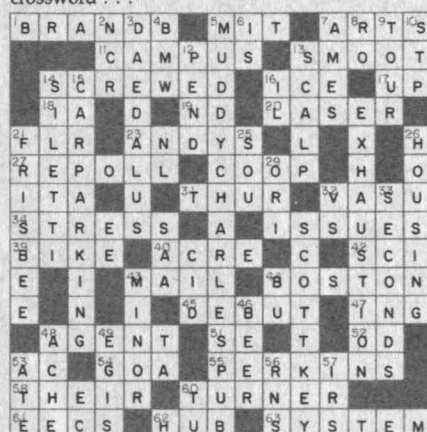
Naive was I ere I saw Evian—M. Perrier

An ole crab was I ere I saw Barcelona—Franco

A slut was I ere I saw Tulsa—name withheld

**FM 5.** Much to my surprise, John Chandler did not have too much trouble with this crossword. He writes as follows:

This isn't really a proper crossword puzzle, since there are 27 squares with no "cross" word, and the fact that clues for 13A, 37A, 21D, 35D, 36D, 38D, and 41D are missing doesn't help at all. Indeed, the labels and clues for 21 and 22 are scrambled, there are typos in the clues for 60D (should be "Et—, Brute") and 18A (a suffix can't possibly be medial: I assume it should be medical). Still, I can't resist a crossword...



I must confess that I'm a little unsure of 14D (and consequently 18A) and 32A (which crosses an undefined word), but otherwise, it seems pretty clear-cut.

Also solved by Thomas Goldfrank and the original *Graduate Student News* proposer, David Waggener. Mr. Waggener notes that GSN did add a few typos.

**Better Late Than Never**

**1987 OCT 4.** John Silvasy believes the width is 26.458 and the length is 13.333.

**1987 OCT 5.** Thomas Murley reports that he wrote a paper on this subject at M.I.T. in 1964.

**JAN 1.** Matthew Fountain has responded.

**JAN 2.** Matthew Fountain and Edward Dawson have responded.

**JAN 3.** Charles Markham, Matthew Fountain, and Edward Dawson have responded.

**JAN 2.** Doug Tritsch, Matthew Fountain, and Edward Dawson have responded.

**Proposers' Solutions to Speed Problems**

**SD 1.** By a well known theorem of Euler,

$$\prod_p (1 - 1/p)^{-1} = \sum_{n=1}^{\infty} 1/n$$

But the right hand side is the famous "Harmonic series."

**SD 2.** Neither; they are the same.

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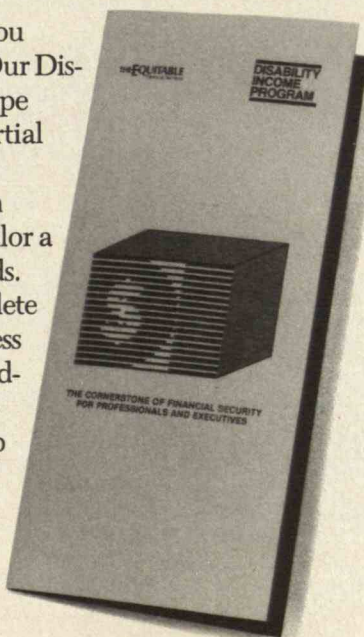
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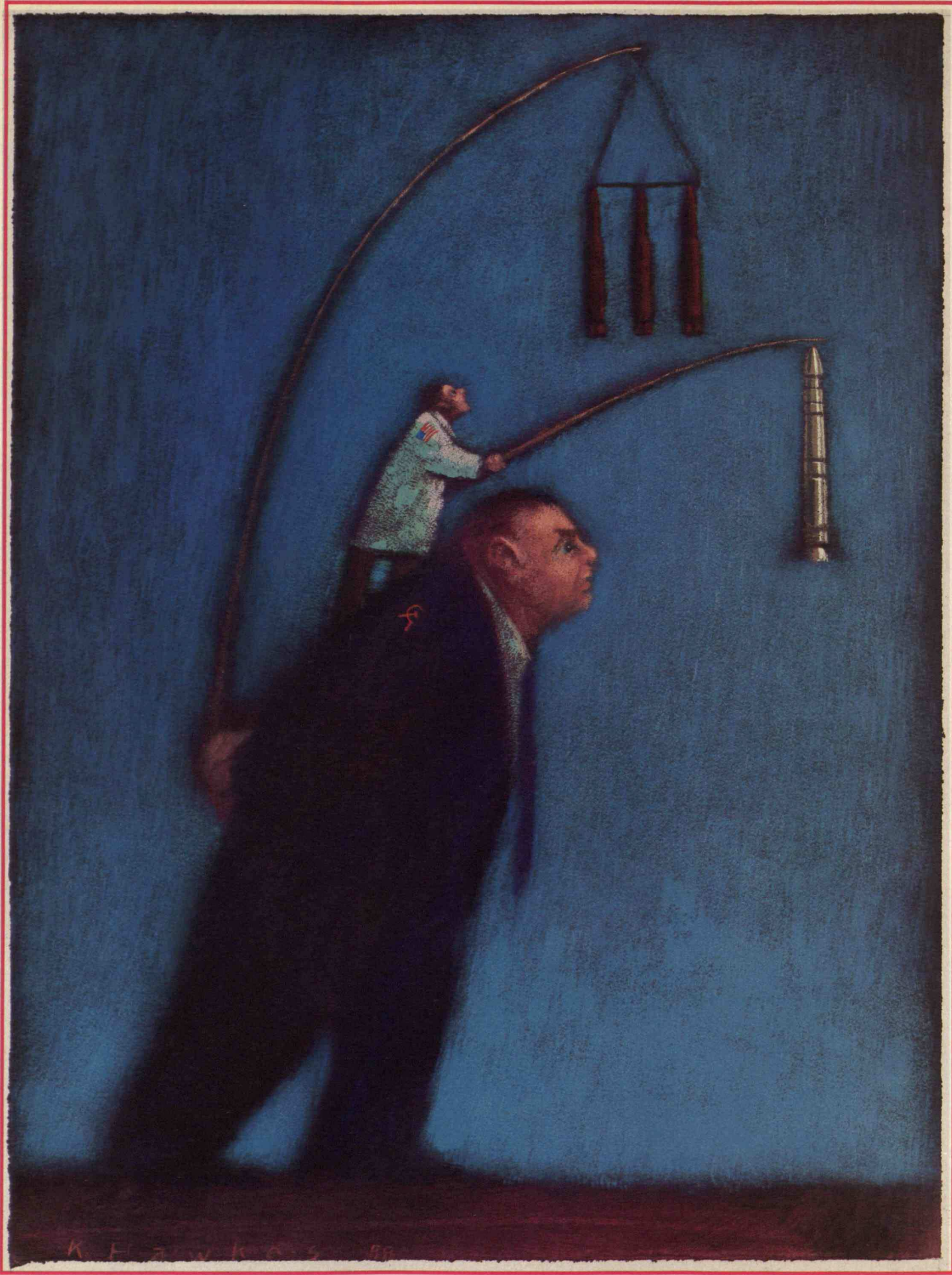
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# How Technology Fuels the Arms Race

**F**ROM the 1985 Geneva summit to the meetings in Moscow last May, the thaw in superpower relations has raised hopes for a comprehensive U.S.-Soviet arms-control agreement. But amidst all the speculation about the elements of a possible settlement, observers have overlooked a central issue. The persistence of the arms race is deeply rooted in contrasting U.S. and Soviet approaches to weapons innovation, approaches that reflect the very different characters of the two societies.

The relative openness of U.S. society shapes the development of new weapons in this country. Compared to the Soviet Union, U.S. military research and development is widely decentralized, encouraging the free flow of information and rewarding low-level initiative. As a result, the process of weapons innovation takes place from the "bottom up" with scientists and technologists in government and the private sector playing a leading role. This process fosters the attitude that technological innovation is the surest guarantor of national security.

In the more closed Soviet Union, military R&D is highly centralized, hierarchical, and characterized by excessive secrecy and compartmentalization—all of which inhibit technological innovation. But these very same characteristics allow the Soviet Union to concentrate its resources from the "top down" and respond to U.S. technological initiatives by mass-producing weapons.

For decades these two systems have been locked in a vicious circle. The United States has depended on technological innovation to provide a decisive advantage over the Soviets. The Soviets have depended on the mass production of weapons to overwhelm U.S. technical quality with Soviet quantity. And whenever the Soviets have mastered an American innovation, they have been able to deploy it to negate the original U.S. advantage, often posing an unforeseen and even more serious threat. That threat has served to justify further U.S. innovations, starting the arms-race cycle all over again. In this way, U.S. technological innovation has ended up diminishing rather than enhancing Western security.

The vicious circle can be broken. The factors that have made for the spiraling arms race also hold the seeds for a fundamental U.S.-Soviet agreement on arms reduction—a trade-off of U.S. quality for Soviet quantity. Such a political compromise is the real hope of current negotiations. But achieving it will require that U.S. weapons scientists and technologists give up the false hope of attaining technological superiority once and for all.

*For a  
comprehensive  
arms-control agreement  
with the Soviets, the U.S.  
must give up  
the false hope of  
attaining national  
security through  
technological  
superiority.*

In this country, the creation of a new weapons system generally begins when scientists in arms laboratories or military officials in close contact with them start to champion new technical possibilities in the government bureaucracy. The nuclear-powered submarine was largely the product of one such technical entrepreneur—Hyman Rickover. Starting in the mid-1940s as an unknown navy captain with a



background in engineering, Rickover persuaded his superiors at the Atomic Energy Commission and the navy's Bureau of Ships to support the development of nuclear propulsion for submarines. His efforts attracted the backing of influential members of Congress and eventually earned him the rank of admiral and the title of "father of the nuclear navy."

Similarly, the nuclear physicist Edward Teller was the patron behind the development of the hydrogen bomb in the early 1950s. While working on the Manhattan Project, Teller was preoccupied with the idea of a "superbomb" based on nuclear fusion rather than fission. After the war, he successfully lobbied Congress to establish a second nuclear weapons lab in Livermore, Calif., claiming that scientists at Los Alamos opposed hydrogen weapons. Even before coming up with the major design breakthrough for the H-bomb, Teller was already trying to interest air force officials and lawmakers in the weapon. Thus began a long and remarkably successful career of influencing U.S. military policy through contacts in the Pentagon, Congress, and the military-technical community.

Sometimes, scientists will advocate a particular arms system as an alternative to weapons they oppose. Tactical nuclear weapons were developed in the early 1950s largely because some U.S. scientists, J. Robert Oppenheimer among them, disagreed with the prevailing policy of strategic bombing and Teller's plans for the H-bomb. At the height of the Korean War, Oppenheimer and his colleagues thought tactical warheads for actual use in combat were more relevant to U.S. military requirements. Ultimately, the United States developed both weapons.

Once a particular system gains the backing of

enough civilian or military technologists, their enthusiasm can often keep it going under private sponsorship, even when high-level government officials try to eliminate it. In 1949, the air force decided to cut back on the Convair Corp.'s research on ballistic missiles—weapons that threatened to undermine the Strategic Air Command's preferred reliance on

bombers. But Convair simply continued research with its own funds until the air force resumed sponsorship of the program in 1951. The project eventually became the Atlas intercontinental ballistic missile (ICBM). (See also "Money, Politics, and the B-1 Bomber," April 1988.)

Such low-level initiative in the absence of high-level support has subsequently been institutionalized in the U.S. military research and development community, at a cost to taxpayers of several billion dollars a year. Under the Pentagon's Bid and Proposal (B&P) program, private corporations can charge the costs of preparing unsolicited proposals for additional new weapons as overhead on their Defense Department contracts. The Independent Research and Development (IR&D) program allows firms to recover the research-and-development costs of projects that they have initiated,

without a prior government contract or any congressional oversight.

### Building Consensus and Countering Threats

Once a new technology is identified, its designers actively promote military applications by "consensus building." Creating a consensus around a weapons system starts with the military-technical community and gradually reaches to top military officials, members of Congress, and usually officials in the executive branch. Sometimes, it can take years or even decades.

Consider the neutron bomb, a weapon that kills primarily with neutron radiation rather than with



*The U.S. pursues  
"bottom up" technological innovation  
to develop new weapons, while  
the Soviets focus on "top down"  
mass production.*

MATTHEW EVANGELISTA is assistant professor of political science at the University of Michigan. This article is adapted from *Innovation and the Arms Race: How the United States and the Soviet Union Develop New Military Technologies* (Cornell University Press, 1988).



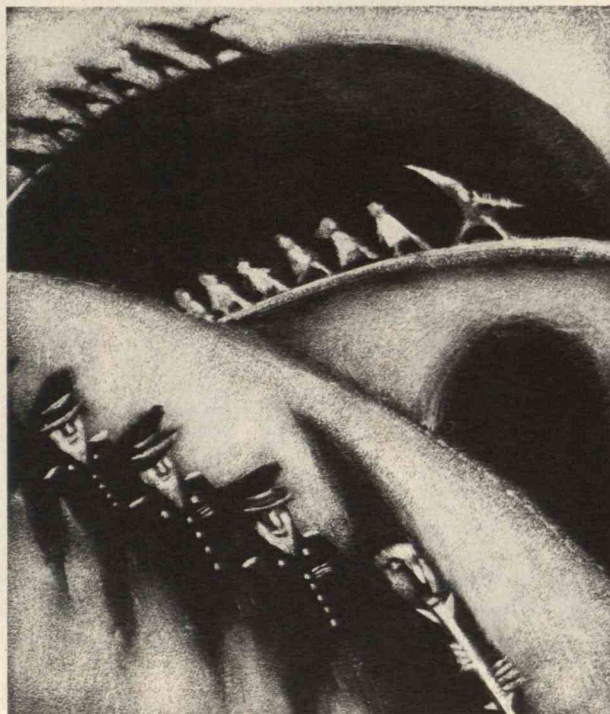
the blast, heat, and gamma radiation of standard fission and fusion weapons. The major conceptual breakthrough for the bomb occurred in 1958, a result of the work of physicist Samuel Cohen at the Rand Corp. Over the next 20 years, Cohen, Teller, and other supporters went from the air force to the navy to the army in search of support for the weapon—at first with little success.

In 1973, however, when Congress turned down an army request for the development of a new nuclear artillery shell, the service somewhat reluctantly came to support the development of neutron warheads, in the belief that championing a new kind of tactical nuclear weapon was the only chance to get a new artillery shell. Five years later, President Carter ordered production of a neutron-bomb warhead for the Lance missile. And in 1984, Congress finally approved a program for a neutron-bomb artillery shell—in an obscure amendment attached to the Defense Authorization Bill and passed without a roll-call vote.

Consensus-building has an important influence on the design of U.S. weapons systems. For one thing, many related programs are often pursued at the same time so as not to exclude any potential supporters for a given technology. This leads to redundancy in weapons produced. The classic example is the development of intermediate-range ballistic missiles (IRBMs) in the 1950s. Both the army and the air force worked on the weapons, ultimately producing two virtually identical systems—the army's Jupiter and the air force's Thor.

A second common method for creating consensus is to incorporate all the technical features or capabilities desired by potential supporters into a system. The result is weapons of greater technical sophistication than is necessary or desirable for a given military mission. The F-111 aircraft was the unhappy product of such a logrolling consensus. Promoters designed the plane with variable-sweep wings on the

theory that it could fulfill a variety of missions for both the navy and the air force, including air-to-air combat, close-air support of ground troops, and long-range bombing. But because of persistent technical problems with this advanced design, the F-111 fulfilled none of these missions well and cost far more than anticipated.



*Weapons designers  
in the U.S. have to create a consensus  
among military and  
political officials.*

Of course, as the neutron bomb example suggests, not all proposed weapons immediately win military or government approval. Often one branch of the military resists a particular innovation that it fears will jeopardize its own organizational traditions or mission. So, promoters of new weapons systems emphasize the inability of current weapons systems or organizational structures to deal with foreign threats. For example, the air force's interest in intermediate-range missiles during the mid-1950s was evidently triggered by concern that the army's IRBM program would yield a system that could replace aircraft in many important combat missions, such as deep interdiction attacks against major air bases and supply depots. Yet both services justified their programs by exaggerating the danger of a Soviet ballistic-missile threat.

Once a weapon has received sufficient support from the services and from key congressional committees to enter advanced R&D, promoters frequently look for events to justify producing a prototype. The classic example is the Soviet Union's October 1957 launching of *Sputnik*. Although the Soviets had already tested an ICBM the previous August, the *Sputnik* satellite was a more dramatic demonstration of the technical capacity for launching long-range ballistic missiles. It spawned fears of a "missile gap" and transformed the U.S. ICBM from a project supported mainly by the air force and its contractors into a top-priority crash program.

This is not to say that factors like *Sputnik* actually cause the development of new weapons. Rather, they



speed up a process already well underway. In fact, the weapons promoted as responses to such threats are often unsuited to them or unnecessary. In the case of the missile gap, President Eisenhower was confident that U.S. strategic bombers could adequately counter any emerging Soviet missile capability, and no crash program to mass-produce U.S. ICBMs was required. Nevertheless, the fear of a missile gap was used by the military services, arms manufacturers, and Democratic presidential candidates in 1960 to push for ICBM development and deployment. The Kennedy administration's missile buildup confirmed Eisenhower's worst fears and led to a major acceleration of the arms race.

Typically, U.S. weapons systems receive high-level political endorsement only at the final stage of the innovation process. Promoters seek wide public and congressional support so as to secure full funding for large-scale production of the weapon. Often under greater scrutiny than during earlier stages, the program generally must be justified with reference to a more specific threat or opportunity. But because promoters of the new weapon have already amassed considerable bureaucratic backing, their rationales need not be too realistic. President Kennedy's decision in early 1961 to accelerate deployment of 1,000 Minuteman missiles, even after it became obvious that the missile gap was clearly in favor of the United States, constitutes a prime example.

At first glance, the most recent U.S. attempt at a major weapons innovation, the Strategic Defense Initiative (SDI), would seem to contradict the process outlined here. Surely, the argument goes, SDI was launched from the very top in President Reagan's March 1983 speech, at a time when the relevant technologies were immature at best. Pressure for strategic defenses had, however, been building up from the bottom for many years before the president's speech, and research was already proceeding

at the rate of about \$1 billion per year.

As with tactical nuclear weapons and the neutron bomb, the initiative for Star Wars came from physicists and weapons designers associated with government laboratories. Once again Edward Teller played a central role, as did some of his protégés at the Livermore Laboratory—most notably Lowell

Wood, leader of the "O Group," which invented the nuclear-pumped X-ray laser. Starting more than a year before the Reagan speech, Teller promoted the laser and other defense technologies in meetings with members of Reagan's "kitchen cabinet" and with the president himself. What is different about the SDI case is that the scientific and military proponents of the system gained access to top political leaders before the process of consensus building in the military-technical community was complete.

### Churning Out Missiles "Like Sausages"

The Soviet Union enjoys a high level of scientific talent and devotes more resources to military R&D than any other country in the world, with the possible exception of the United States. In many respects, however, the Soviet pattern of arms development reverses the U.S.

pattern. There is little technological innovation until the later stages of the development process, when foreign events spur high-level political intervention to pave the way by restructuring priorities.

This contradicts the conventional wisdom that the Soviet military's privileged status protects it from the shortcomings of the rest of the economy and makes it an island of innovation, employing the country's top scientists. But recent memoirs and descriptions by Soviet émigré scientists and engineers who have worked in military R&D suggest that the system's centralized, secretive nature, which is *strongest* in military research, acts to inhibit innovation.

For example, the secret nature of the work means that military scientists are not allowed many civilian



## *The centralized and secretive nature of Soviet military R&D inhibits initiative and innovation.*



advantages such as contact with foreign colleagues and the ability to publish articles and books in the open press. And even though salaries are sometimes higher in the military sector, they cannot be supplemented in the way that civilian salaries can—by fees from consulting, tutoring, writing, and lecturing. Therefore, the most ambitious and capable scientists often seek employment in the civilian sector.

Secrecy also severely inhibits how Soviet weapons labs function. Security personnel—members of the so-called First Department—rather than scientists and technologists determine work procedures and access to information. For instance, a researcher at a Soviet military design bureau who wants to visit a colleague at another establishment where classified work is conducted faces a daunting set of security procedures. To obtain permission for the trip requires considerable preparation and paperwork, the constant issuing and verifying of passes, and the filling out of forms. Upon arriving at the colleague's institute, the researcher faces the same security practices as at the home institute, including the ban on retaining any notes. Notes must be written into pre-numbered notebooks and presented to the First Department. The department then sends the notebooks by special mail to its counterpart at the home institute, where they are deposited in the researcher's classified portfolio.

This stultifying atmosphere shapes the Soviet innovation process. At first, Soviet weapons scientists devote some resources to keep up with research in a particular area, especially by monitoring foreign developments. Then, depending on events abroad, weapons labs and research bureaus may start to prepare a broad technological background that might prove useful later, should efforts ever be accelerated in response to an identifiable foreign threat. But in the absence of explicit political direction, work on particular weapons systems goes no further.

Consider tactical nuclear weapons. As early as 1946, when they first learned of the existence of the atomic bomb, some officers studying at Soviet military academies expressed interest in the impact of nuclear weapons on the battlefield. Yet while there was a widespread published discussion of this issue in the United States, Stalin's policy of strict nuclear secrecy did not even allow teachers to broach it in class. The Soviets focused instead on strategic uses for nuclear weapons.

Only after the United States deployed short-range atomic weapons in Europe in 1952 did the Soviet political and military leadership decide to reassess its priorities. In the short term the Soviets restructured their air defense forces to respond to nuclear attack and began instructing soldiers in the effects

of nuclear weapons. Then in 1953, Soviet leaders initiated programs to develop both tactical nuclear weapons and the delivery vehicles to carry them. They hedged their bets by ordering development of all the systems that they knew the Americans were working on—missiles, artillery, and aircraft.

Such a chain of events is typical of the Soviet system. In the final stages, when the Soviet leadership endorses an all-out effort to pursue a particular innovation, the change in priorities that allows the system to overcome its usual inertia becomes especially evident. To promote the development of missiles in the postwar period, Soviet leaders established a new network of research institutes, plants, and design bureaus. By 1948, some 13 scientific institutes and 35 major factories were involved in designing and manufacturing missiles, under the direction of Soviet rocket expert Sergei Korolev.

Although the specific character of new Soviet weapons programs is, to a certain extent, shaped by existing military organizations and technologies, the top leadership still retains the ability to intervene in the process of carrying out an innovation. In the late 1950s, Soviet leader Nikita Khrushchev canceled production of the expensive and technically unsuccessful "atomic cannon" in favor of an emphasis on missiles, and, to a lesser extent, aircraft. In the United States, by contrast, large atomic artillery pieces continued to be produced, despite serious criticisms of their capabilities.

The Soviet innovation process concludes when a particular weapons system moves into mass production. This normally corresponds to the first public evidence of a change in policy. In the case of ballistic missiles, Khrushchev announced in January 1960 that the Soviet Union believed a future war would inevitably be fought with nuclear missiles and that assembly lines at Soviet aircraft factories had therefore all been converted to missile production. Later the same year he announced the formation of a new military branch—the Strategic Rocket Forces—and boasted that the Soviet Union was churning out missiles "like sausages."

### The False Hope of Technology

Khrushchev was bluffing when he made his claims about Soviet missile superiority. Yet in the wake of the Kennedy administration's buildup and Soviet humiliation during the Cuban missile crisis, Khrushchev's successors were determined to overtake the United States in the major quantitative indicators of strategic nuclear power—most notably intercontinental missiles. The Soviets had barely caught up when the United States inaugurated another key



phase of the arms race by deploying the multiple, independently targetable reentry vehicle, or MIRV, that allowed a single missile to carry several warheads.

Adding MIRVs to U.S. missiles increased the number of deliverable strategic warheads from a couple thousand in the early 1970s to nearly 10,000 by the end of what Ronald Reagan has called the "decade of neglect" in U.S. military policy. But the Soviets eventually developed MIRVs as well and placed 10 warheads on each of their 308 "heavy" SS-18 missiles, thus posing the theoretical first-strike threat that has been a major source of concern among U.S. military planners and politicians ever since. The MIRV, which had once appeared to be a kind of technical panacea, is now understood, even by former proponents such as Henry Kissinger, to be perhaps the most dangerous and potentially destabilizing development in the Soviet-American arms race to date.

This pattern of escalation characterizes not only the past but possibly also the future of Soviet-American arms competition. We are now at a point where recent U.S. innovations such as cruise missiles, deep-strike conventional weapons, and SDI present the Soviets with crucial choices about how to respond. Certainly, they are capable of matching these innovations—whether through emulating U.S. initiatives or developing effective countermeasures to them. Either response would serve to diminish the security of both sides.

When the United States developed advanced cruise missiles during the 1970s, their promoters described them as another technical solution to the West's security problems, especially well-suited for negating Soviet quantitative advantages in air defense. But now the Soviets have developed their own cruise missiles. Unless restricted by verifiable arms-control agreements, they could be mass-produced and deployed on virtually any Soviet fishing trawler or commercial airliner—rendering any U.S. security gain chimerical.

The Soviets have also closely followed U.S. developments in the area of deep-strike weapons, ever since the relevant technologies—especially remote sensors, information-processing and target-acquisition systems, and cluster munitions—appeared during the Vietnam War. Prominent military figures such as Marshal Nikolai Ogarkov have argued that nuclear parity magnifies the importance of these high-tech systems for conventional warfare. Some Western observers believe that Gorbachev's economic reforms are specifically geared toward preparing the Soviet Union to compete in the realm of advanced military technology into the next century.

If the Soviets develop deep-strike weapons in large quantities, and incorporate them into offensive military strategies, NATO's security will surely suffer.

Potential Soviet responses to a U.S. strategic defense system are already well known and need no further elaboration here. Whether the Soviets eventually try to create a defensive system of their own or simply offset any potential U.S. system by deploying countermeasures, SDI will render the United States less secure than it was before the program was ever proposed. SDI also poses an immediate threat to potential arms-reduction agreements. Without a U.S. commitment to abide by the 1972 Anti-Ballistic Missile (ABM) Treaty and refrain from deploying large-scale strategic defenses, the Soviets would be unlikely to carry out extensive reductions of their MIRVed ICBM force—the best SDI countermeasure they have.

### Trading Quality for Quantity

The elements of a grand compromise to avert the next spiral in the arms race have been evident virtually from the moment Ronald Reagan announced the Strategic Defense Initiative in March 1983. SDI would be employed as a "bargaining chip" to get the Soviets to agree to substantial reductions in their force of MIRVed SS-18 missiles. Such an agreement would require each side to make sacrifices in its primary area of strength—for the United States, the ability to initiate technological innovations; for the Soviet Union, the ability to imitate those innovations and produce them in large quantity. Put another way, the arms-control deal that has received so much attention entails U.S. restraint in the next major technological innovation, strategic defense systems, in return for Soviet cutbacks in the previous major innovation, multiple-warhead ICBMs.

What appears to observers to be an ideal compromise may be perceived by the protagonists as giving up their sole source of strength—as Ronald Reagan's unwavering commitment to SDI suggests. However, the treaty eliminating shorter- and medium-range missiles, signed in Washington last December, is in a sense just such a trade of comparative advantages, of quality for quantity. The SS-20 represented the Soviet Union's first successful, large-scale deployment of a technology—solid-fueled MIRVed missiles—that the United States had mastered years earlier. The new U.S. missiles, by contrast, are state of the art. In particular, the Pershing II is considered the world's most accurate ballistic missile. The treaty is largely the result of the Soviet Union's willingness to trade its numerical advantage in medium-range missiles in exchange for the United



States relinquishing its technological advantage.

Gorbachev's recent initiatives suggest a preference for an alternative to the competition in military technology with the United States. During the mid-1980s, the Soviets took a number of actions intended to persuade the United States to agree to arms limitations. They maintained a unilateral moratorium on nuclear testing for over a year and a half, while the United States exploded more than 25 nuclear devices. They halted deployment of SS-20 missiles targeted against Europe and withdrew some 35 of them, even as the United States continued deploying Pershing II and cruise missiles. They refrained from testing antisatellite weapons (ASATs), and they allowed unprecedented measures of on-site inspection to verify compliance with arms agreements. U.S. scientists were even permitted to set up seismic monitoring equipment adjacent to Soviet nuclear test ranges. The treaty removing missiles from Europe entails even more intrusive measures of verification, including monitoring of missile factories.

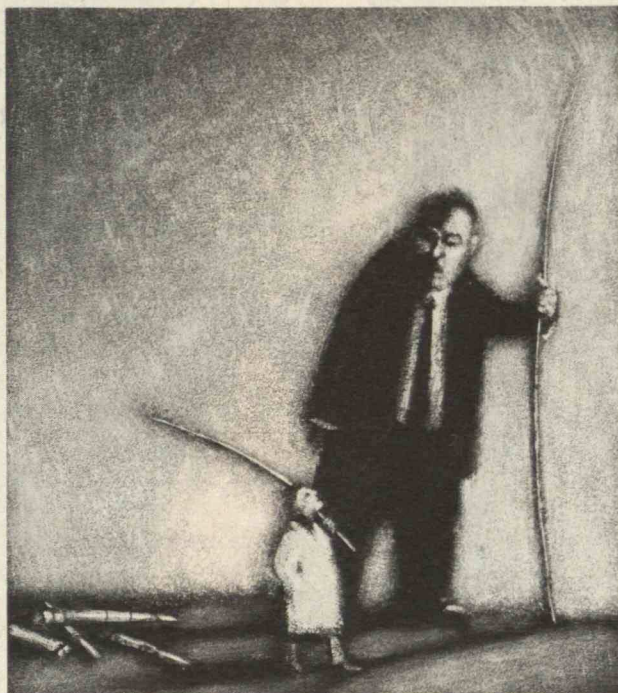
Soviet leaders seem to realize that although their nation has been able to match U.S. innovations and produce them in large numbers, these actions have served to justify new U.S. weapons developments. U.S. officials and scientists should recognize that unilateral U.S. advantages—especially in the realm of technology—are short-lived and provide no guarantee of security. In acknowledging the counterproductive nature of the technological arms race, both countries would open the way to cooperative agreements aimed at ending it.

How can this mutually advantageous outcome be achieved? In the tradition of the Soviet system, the initiative comes from the top. It clearly bears the mark of Gorbachev and his main advisers. In the United States, where the scope for low-level initiative has always been much greater, recent developments suggest that scientists are stepping in to promote serious measures of arms control despite the reluct-

ance of their government.

The U.S. side of the agreement to monitor the Soviet nuclear test moratorium, for example, was a private initiative, organized by the Natural Resources Defense Council and funded by private donations. American scientists have been major participants in the movement to preserve and strengthen the ABM Treaty. Many of them have signed pledges refusing to conduct SDI-related research. Scientists have also put pressure on Congress to limit funding for ASATs so long as the Soviets maintain a moratorium on testing theirs. These efforts have contributed to averting a counterproductive and potentially dangerous ASAT race.

This is hardly the first time that scientists have taken a stand against an unconstrained technological arms race. The ABM Treaty itself testifies to past initiatives. Yet there remains much to do. Efforts to secure a comprehensive nuclear test ban should continue, in hopes that the next administration will reaffirm the longstanding formal U.S. commitment—broken only by the Reagan administration—to this goal. In addition, U.S. scientists could work with their Soviet counterparts to



*Acknowledging  
the counterproductive nature of  
the technological arms race would  
make both superpowers  
more secure.*

develop means of verifying limitations on sea-launched cruise missiles. Otherwise, these weapons threaten to open an enormous loophole in the European missile treaty as well as in any potential strategic weapons agreement.

The importance of such actions at the present time lies in the enhanced prospects for success. The international atmosphere has finally improved, and the increasingly frequent superpower summits suggest that U.S.-Soviet relations are on the way to normalization. The current leadership in the Kremlin recognizes the futility of the arms race and has made real concessions to demonstrate a serious intent to end it. All that remains is for the next American administration to demonstrate comparable flexibility and political will. □





“**T**HE  
QUESTION WE'RE  
TRYING TO RAISE IS, DO  
WE WANT TO SAVE THE  
EARTH?”



# The State of the World

An Interview  
with Lester Brown

**E**ACH year since 1984, the Worldwatch Institute of Washington, D.C., has published the State of the World, an assessment of worldwide progress toward achieving a sustainable society. That report, says

Time magazine, is "arguably a more accurate and provocative picture of the globe than the one sketched by the President" in his State of the Union address.

Behind both the book and the institute are Lester Brown, previously a farmer, a food-policy analyst with the U.S. Department of Agriculture, and a senior fellow at the Overseas Development Council. In 1975 he founded the Worldwatch Institute to, as he says, "raise the level of public awareness on important threats to the human future to the point where it will support an effective political response."

Worldwatch Institute quickly drew wide attention. In late 1975, a New York Times front-page story covered the first Worldwatch paper, "The Other Energy Crisis: Firewood" by Worldwatch researcher Erik Eckholm. That paper influenced forestry programs and policies worldwide. As Brown explains, "Everyone was thinking about the fourfold increase in the price of oil, but Erik wrote about Third World firewood scarcity. It was something that anyone who'd been in Af-

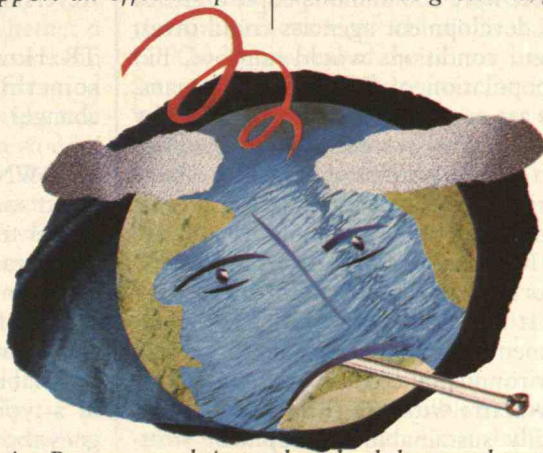
ghanistan or Peru or India knew about, but no one realized how pervasive it was. This was the energy issue for a billion and half of the world's people."

In describing Worldwatch's approach, Brown compares it to his

background as a farmer. "A farmer is by nature interdisciplinary. Farmers have to worry about economics, about their markets. They have to worry about weather. They have to worry about soils, entomology, and plant nutrition. And so the kind of research that Worldwatch does comes naturally as an extension of that."

Through a well-developed network, Worldwatch now gathers information from all over the world, analyzes it, and then disseminates the results. The audience for its research has grown large enough that the institute, originally funded by foundations and United Nations agencies, today earns over half its budget from royalties and sales. Says Brown, "We had not expected as a research institute to see such a strong demand for our publications. Some of the Worldwatch papers have passed the

hundred thousand mark in several languages. The message will soon reach an ever wider audience. In cooperation with Worldwatch, WGBH in Boston is producing a 10-part television series on global environmental issues







“INDIVIDUAL COUNTRIES DO NOT HAVE INDEPENDENT ECOSYSTEMS. WE NEEDED TO SKETCH A FRAMEWORK IN WHICH TO SEE HOW THIS WORLD IS TIED TOGETHER.”

based on the institute's State of the World reports. The series is scheduled to air in the United States and over the British Broadcasting Corporation in 1990.

Technology Review senior editors Sandra Hackman and Marc S. Miller interviewed Brown at the Worldwatch Institute.

**TECHNOLOGY REVIEW:** What is the state of the world's health?

**BROWN:** It's deteriorating. In doing the *State of the World* report each year we, in effect, give the earth a physical. According to every major vital sign, it's been deteriorating. We haven't been able to identify one sign that has improved during any of the five years that we've been doing *State of the World*. Forests have gotten smaller each year, the deserts have gotten larger. The topsoils have gotten thinner. The ozone layer is apparently being depleted. The atmospheric CO<sub>2</sub> levels are rising. Biological diversity is diminishing. Toxic wastes are accumulating.

**TR:** What caused that deterioration?

**BROWN:** There are an awful lot of us. We should have been dancing in the streets last July when we reached the 5 billion mark: it's a major accomplishment in evolutionary terms. But there weren't any celebrations. Instead, there was a strong undercurrent of concern about our reaching 5 billion. And rightly so.

We have reached the point in development in places like Africa where we have to recognize that simply applying economic criteria to development projects is no longer viable. When there were 200 million people in Africa in 1950, development agencies could invest money and conditions would improve. But with a population of 580 million humans, demands are exceeding the carrying capacity of local biological systems, leading to consumption of the systems themselves. That's why Africa's forests are disappearing, its grasslands are deteriorating, and its soils are eroding. Investing in saw mills or meatpacking plants now may only speed the deterioration. It's a very different ballgame. Development policies that are not grounded in an environmental context are failing. Success now starts with the formulation of an ecologically sustainable development strategy. Once this ecological framework is in place, planners can shape economically viable policies and projects. Lower fertility and smaller families are simply not happening in most of Africa and much of Latin America because economic and social conditions are not improving.

**TR:** Why do you approach problems from a global perspective when most decisions are made on a national level?

**BROWN:** Individual countries do not have independent ecosystems. For example, we share a climatic system. We needed to sketch a framework in which to see how this world is tied together. In *State of the World*, there's a quote from Maumoon Abdul Gayoon, the president of the Maldives in the Indian Ocean, who says that his is an endangered nation. It is endangered by the energy policies of nations over which it has no control. Continuing heavy reliance on fossil fuels will lead to a rise in atmospheric CO<sub>2</sub> and a warming of the earth. The resulting rise in sea level could engulf much of his nation of islands, many of which are only a few feet above sea level.

The whole world has a stake in the Soviet Union's economic reforms. If they succeed, the energy efficiency of the Soviet economy will increase dramatically, helping to slow the rise in atmospheric carbon dioxide.

I think Gorbachev is one of the better informed national leaders on environmental issues. In *State of the World 1984*, we quoted him when he urged a national effort to control soil erosion in the Soviet Union—that's when he was a member of the politburo. Most Americans had never heard his name. Within a year or so after he was in office, the Soviets decided to abandon their long-standing dream of turning around the rivers that flowed north. In talking with senior people in Moscow, there's no question in my mind that they're now aware of environmental issues.

### Reversing the Trends

**TR:** How does one get government action on something as hard to grasp as climate change?

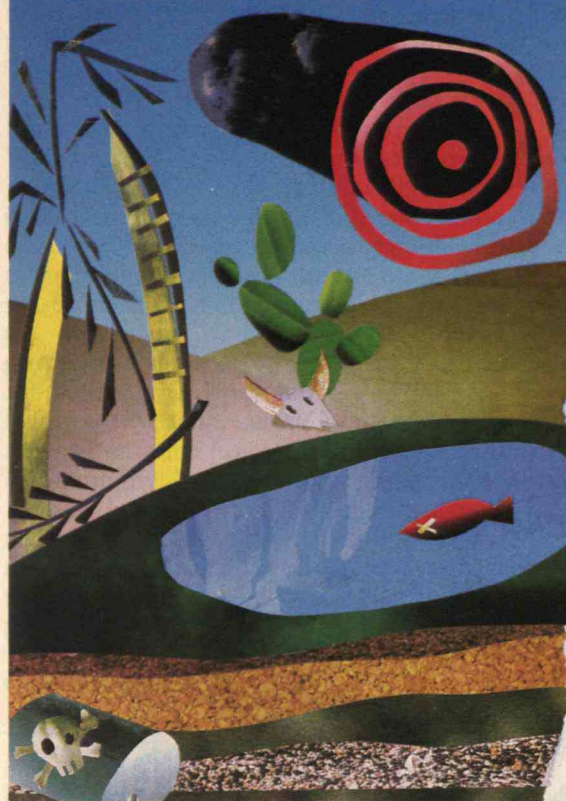
**BROWN:** Climate change is a terribly abstract sort of thing to be talking about, with global temperature changing a few degrees Centigrade. But when it is localized, it becomes much more meaningful. Take the predictions for Washington, D.C. If atmospheric CO<sub>2</sub> concentrations reach double the pre-industrial levels, instead of having just one day in a typical summer when the temperature goes above 100 degrees Fahrenheit, it's going to be 12 days. And instead of 36 days when the temperature goes above 90, there will be 87 such days. When you bring the warming trend down to the Washington level, then anyone who's spent a summer here responds.

**TR:** Can an organization like Worldwatch



## THE EARTH'S VITAL SIGNS

### *Changes in the Earth's physical condition*



|  |  |
|--|--|
| <b>FOREST COVER</b>                    | Tropical forests shrinking by 11 million hectares per year. 31 million hectares in industrial countries damaged, apparently by air pollution or acid rain.         |
| <b>TOPSOIL ON CROPLAND</b>             | An estimated 26 billion tons lost annually in excess of new soil formation.  |
| <b>DESERT AREA</b>                     | Some 6 million hectares of new desert formed annually by land mismanagement.   |
| <b>LAKES</b>                           | Thousands of lakes in the industrial north now biologically dead: thousands more dying.  |
| <b>FRESH WATER</b>                     | Underground water tables falling in parts of Africa, China, India, and North America as demand for water rises above aquifer recharge rates.                       |
| <b>SPECIES DIVERSITY</b>               | Extinctions of plant and animal species together now estimated at several thousand per year: one fifth of all species may disappear over the next 20 years.        |
| <b>GROUNDWATER QUALITY</b>             | Some 50 pesticides contaminate groundwater in 32 American states; some 2,500 U.S. toxic waste sites need cleanup: extent of toxic contamination worldwide unknown. |
| <b>CLIMATE</b>                         | Mean temperature projected to rise between 1.5 and 4.5 degrees Celsius between now and 2050.   |
| <b>SEA LEVEL</b>                       | Projected to rise between 1.4 meters (4.7 feet) and 2.2 meters (7.1 feet) by 2100.   |
| <b>OZONE LAYER IN UPPER ATMOSPHERE</b> | Growing "hole" in the earth's ozone layer over Antarctica each spring suggests a gradual global depletion could be starting.                                       |

make a difference? For example, despite 15 years of attention to the importance of tropical forests, their destruction continues.

**BROWN:** Maybe the question is whether a lot of organizations working on the issue can make a difference. I could use the firewood example. At the time of the Worldwatch paper "The Other Energy Crisis: Firewood," a World Bank forestry project was likely to be building a road into a tropical rain forest, creating the infrastructure so that Weyerhaeuser or someone could get hardwoods out, thereby earning foreign exchange for the country to help finance development. Within a couple of years after the Worldwatch paper was published, the bank had issued a forestry-sector paper that drew heavily on it. Today, the World Bank must have firewood projects in 35 countries around the world, and watershed restoration projects in 10 or 15 more. Forestry lending at the World Bank has been transformed. Have we reversed the deforestation of the earth? Not yet, but I can now visualize a scenario in which we could do so before the end of the century.

Here and there one can point to other success stories in responding to a threat. The Montreal Accord last September, in which the international community agreed to halve the manufacture of chlorofluorocarbons (CFCs) by the end of the century, is a major step forward. It took quite a bit of public education by a lot of people to get the international community to become sufficiently aware of the threat CFCs posed to the ozone layer and the upper atmosphere.

**TR:** Why do you think action was taken on that particular issue? Was it because the CFC issue was easier to act on than so many others?

**BROWN:** Yes. It was possible to put the CFC agreement together because it didn't require an enormous restructuring of national economies in the way that an agreement on reducing CO<sub>2</sub> emissions from fossil-fuel burning would. But we wouldn't have to restructure economies to have a significant effect even on CO<sub>2</sub> emissions. If we could just double automobile fuel efficiency again in the

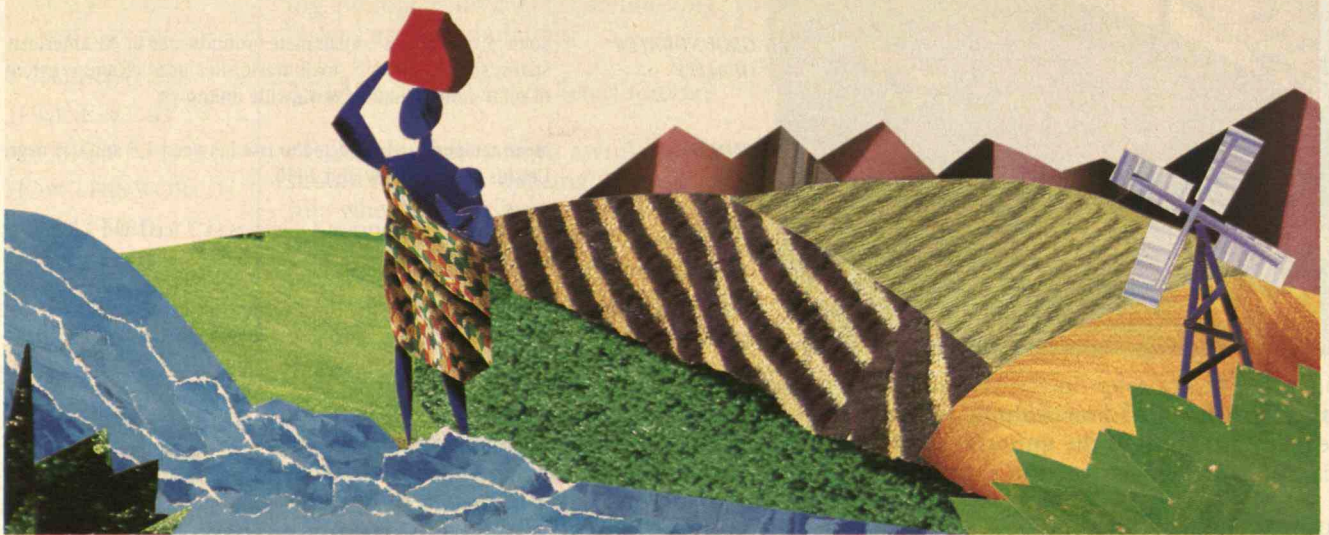
**“W**E’VE HAD TWO ENVIRONMENTAL CRISES WITH A POTENTIAL TO UNDERMINE THE ECONOMIC FUTURE OF THE UNITED STATES, AND BOTH RESULTED FROM SOIL EROSION.”



## RECLAIMING THE FUTURE

*Estimates of additional expenditures to achieve sustainable development (in billions of dollars)*

| Year | Protecting<br>Topsoil on<br>Cropland | Reforestation<br>the Earth | Slowing<br>Population<br>Growth | Raising<br>Energy<br>Efficiency | Developing<br>Renewable<br>Energy | Retiring<br>Third<br>World<br>Debt | Total |
|------|--------------------------------------|----------------------------|---------------------------------|---------------------------------|-----------------------------------|------------------------------------|-------|
| 1990 | 4                                    | 2                          | 13                              | 5                               | 2                                 | 20                                 | 46    |
| 1991 | 9                                    | 3                          | 18                              | 10                              | 5                                 | 30                                 | 75    |
| 1992 | 14                                   | 4                          | 22                              | 15                              | 8                                 | 40                                 | 103   |
| 1993 | 18                                   | 5                          | 26                              | 20                              | 10                                | 50                                 | 129   |
| 1994 | 24                                   | 6                          | 28                              | 25                              | 12                                | 50                                 | 145   |
| 1995 | 24                                   | 6                          | 30                              | 30                              | 15                                | 40                                 | 145   |
| 1996 | 24                                   | 6                          | 31                              | 35                              | 18                                | 30                                 | 144   |
| 1997 | 24                                   | 6                          | 32                              | 40                              | 21                                | 20                                 | 143   |
| 1998 | 24                                   | 7                          | 32                              | 45                              | 24                                | 10                                 | 142   |
| 1999 | 24                                   | 7                          | 32                              | 50                              | 27                                | 10                                 | 150   |
| 2000 | 24                                   | 7                          | 33                              | 55                              | 30                                | 0                                  | 149   |



United States, it would make a big difference. Just as we doubled the fuel efficiency of new automobiles between 1974 and 1986, going from 14 miles to 26 miles per gallon of gasoline, so we could go from 26 miles to 52 miles per gallon by the end of the century if we wanted to.

Another thing that contributed greatly to the CFC agreement was the willingness of several leading scientists working on atmospheric chemistry and ozone depletion to go public quickly with their research findings, to tell the world that this was a serious issue. It's also interesting that the National Science Foundation has initiated discussions with Chile and Argentina about the possible effects of ozone depletion, because those countries have the populated areas that will be first exposed to the expanding "hole" in the ozone layer over Antarctica.

Another example of a success is combating soil erosion in the United States. We've had two environmental crises with a potential for undermining the country's economic future, and both resulted from soil erosion. The first was the dust-bowl period during the '30s. We were losing an enormous amount of topsoil from wind erosion. In the *Grapes of Wrath*, one gets a sense of the environmental deterioration in the Western plains that drove so many people to the West Coast. During the very day an official from the Department of Agriculture was trying to convince Congress to create the Soil Conservation Service, the dust over Washington was so thick that it obscured the sun. An Eastern-dominated Congress began to see that this could be a serious issue.

Then, after the Soviet wheat purchase in '72, the price of wheat doubled, and poor



harvests in major producing countries kept the world grain price at double the traditional level for three or four years. And when the price of oil went up, Earl Butz, who was secretary of agriculture, urged farmers to plant "fence row to fence row" because we needed all the grain we could get to pay the oil-import bill. A lot of land got plowed that never should have, and we were losing about the same amount of topsoil by the end of the '70s that we were in the mid-'30s.

A number of groups—the Conservation Foundation, American Farmland Trust, Worldwatch—began doing studies and raising public awareness. In 1984, when it came time to draft a new farm bill, two strands came together. One was the rising public concern about soil erosion, and the other was a sense that the cost of farm programs had simply gotten out of hand. Environmental groups put the two together and developed a bill that would pay farmers to idle only highly erosive land, instead of merely paying them to set aside just any land regardless of its erodibility. The legislation passed in late 1985 is probably going to eliminate four-fifths or more of the excessive soil erosion in this country. That's a major step toward getting the world back onto a sustainable global path.

### Changing Attitudes

**TR:** How do you go about influencing policymakers through the research you do, as in the case of the World Bank?

**BROWN:** We hold seminars at the bank and I meet with senior staff when invited, but Worldwatch does not take an issue and start pushing it. Our feeling is that if we do a good enough job in the analysis and the ideas are exciting enough, then things will go on their own. And if you're dealing with a global constituency, there's no way an organization this size can establish even phone contact with more than an infinitesimal percentage of decision makers.

**TR:** What change have you seen in the World Bank's approach to environmental issues?

**BROWN:** A few years ago, the bank began to realize that development was failing in Africa after 30 years of effort. Per capita food production was falling. Incomes were going down. It was painful, but the bank had to say that development was not working in Africa. As a result of this painful realization, the bank is setting up an environmental division that is charged with the responsibility of getting development back onto a sustainable path.

**TR:** Does Worldwatch try to bring its issues to the attention of politicians and political candidates?

**BROWN:** I don't think it's so much bringing them to the candidates' attention as bringing them to the public's attention. If the public begins to worry about the depletion of the ozone layer, then the candidates will begin to worry about it. Candidates tend to focus on a relatively small number of issues in their public presentations, ones that they master. Climate change is too abstract and too distant at this point to become a major issue. Toxic waste could well become an issue in this campaign, and probably should be, but whether it will remains to be seen.

**TR:** How have environmental concerns changed? What makes the work of Worldwatch different from what could be called warmed-over '60s or '70s environmentalism?

**BROWN:** When the modern environmental movement was launched with Rachel Carson's *Silent Spring* in 1962, the main problem was pollution—pesticides, industrial pollutants, what have you. But Third World countries were saying, "How do we get the smokestacks?" Since then, those countries have begun to realize that they, too, have some serious environmental problems. These tend to be not so much chemical problems as physical problems like deforestation and soil erosion. In northern parts of Ethiopia, for example, there is not enough topsoil left to support even subsistence farming. The result is recurrent famine.

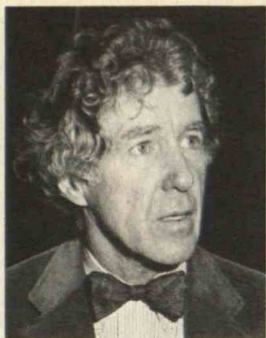
Second, the dimensions of the environmental problem have increased greatly. When we were writing the first *State of the World* in 1984, [Worldwatch senior researcher] Sandra Postel and I were trying to decide whether to have a section on acid rain, because a group of German foresters had discovered that 8 percent of their nation's forests were showing signs of damage. We decided that we should. By *State of the World* 1988, 22 countries in Europe were reporting signs of forest damage. Germany now reports that over half its forests are damaged or dying. You can search the scientific literature of the '60s and '70s in vain for articles that say we've got to be careful with air pollution because it's going to lead to acid rain and damage our forests.

Climate change has been a hypothesis since the beginning of the century. What is new is that in the last year or so two studies were published—one by a team of meteorologists in the United Kingdom and the other by a U.S. Geological Survey team—presenting evidence that the warming is already under way.



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What had been a hypothesis is in the process of becoming a reality.

These are global environmental problems that Rachel Carson didn't even know about, that didn't even seem so important when we were starting *State of the World* in 1984.

**TR:** Has the approach of the business community to these issues changed also?

**BROWN:** A good example of how that change can occur is the appliance-efficiency standards that were passed last year. This legislation will raise the energy efficiency of household appliances much as the fuel-efficiency standards did for automobiles. The appliance-efficiency legislation had been lying around Washington for years. The Carter administration almost got it ready, but not quite. The environmental community kept working on it, and some states passed standards for appliances marketed in their state. And once a few states did that, it made the industry nervous because it could see a complicated world beginning to unfold. And that weakened its resistance to a uniform national standard.

One can find examples of corporations that have acted on their own. Some corporations like McDonald's have occasionally done something unilaterally for environmental reasons, such as phasing out the use of carry-out food containers made with CFCs.

Electric-arc steel furnaces, which are based largely on recycled steel scrap, are becoming a major force in the U.S. steel market, and are the one segment of the market that's been doing very well. This new technology means that you can put a small steel plant in North Carolina or Nebraska and operate with scrap steel, so the automobiles in that area will be recycled. And if you have an industrially mature society like Sweden, with no population growth and an effective recycling system for aluminum or steel, that country can almost live on that recyclable stock.

Changes in environmental support systems affect the economy. Several years ago Dow Corning was rethinking energy options at its main plant in Michigan. They had a choice of signing a long-term electricity supply contract with a local nuclear power plant, but they decided to turn to wood as a fuel. I think they figured that 30,000 acres of land planted with hybrid poplars would support their plant forever. The interesting thing was that they were producing high-tech silicon products in that plant—such as heat-resistant reentry shields for spacecraft—with firewood. They're not doing it because they're altruistic. They analyzed the situation and concluded that wood was by far the cheapest, most secure energy source for them.

**TR:** What is the role of technologists in contributing to a sustainable economy?

**BROWN:** If I were going into engineering, for example, I would ask myself which fields I could make an important contribution to. In energy, the technological frontiers are no longer nuclear power, but things like photovoltaics, which is solid-state physics, or wind power or geothermal energy. The renewable sources are becoming the frontiers in the field of energy.

Engineers could address questions of energy efficiency. How do you design buildings so they don't leak much energy? And how do you design transport systems that don't contribute to carbon emissions and the global warming? These are the questions on which the future of humanity hinges.

**TR:** What particular technological advances excite you?

**BROWN:** I can describe fairly simple technologies that I would find exciting. We think about recycling. We could design containers for beverages that would all be the same. Instead of having containers that you'd throw away, these containers would simply be washed and the labels steamed off and others put on. Using computer technology, we could have an inventory control in which beer bottles wouldn't have to go back to the brewery, but could go to a nearby dairy or be dropped off at a fruit-juice concentrating plant. We could make that system extraordinarily efficient compared to what we have. It's a very simple idea, entirely within our technological grasp.

**TR:** Are you asking technologists to be altruistic?

**BROWN:** I think most people, given a choice, would like to be doing something that makes a difference. We probably get a disproportionate share of young people coming to Worldwatch. A lot of them are extraordinarily talented and could go in almost any direction, some of them very lucrative. But they would rather work here on the issues they are concerned about.

### Redefining Security

**TR:** What would it take to write an upbeat *State of the World* report?

**BROWN:** The question we're trying to raise is, do we want to save the earth? If we do, then we've got to think about some serious reordering of priorities. We estimate that taking the basic steps will cost about \$150 bil-



lion a year. That seems a lot, but it's also only one-sixth the world's military budget—about \$900 billion a year.

We've become hooked on a military definition of security over the past 40 years, and yet for some countries encroaching deserts could be a far greater threat. We need to go back to the drawing board and rethink security. We say in *State of the World 1988* that the winner of the U.S.-Soviet arms race is Japan, and that's gradually dawning on the governments of both superpowers. In the end, security is an economic issue. If a country is losing its soils and its forests, it will eventually lose its productive capacity. Despite our technological advances, we are still as dependent on photosynthesis as we ever were.

If we decide we want to save the earth, then it's going to take a substantial effort and some hefty up-front outlays for planting trees, planning families, conserving soil, increasing energy efficiency, developing renewable energy resources, protecting biological diversity, and reducing Third World debt. Almost all these investments will pay substantial returns, but we've got to get the capital.

**TR:** You propose that each country redirect a portion of its military budget to environmentally sound efforts. Have any countries taken this step?

**BROWN:** This is precisely what China has done over the last decade or so. The Chinese have reduced the share of the GNP used for military purposes by nearly half—from 13 percent in the early '70s to scarcely 7 percent in 1987. They've been shifting those resources into reforestation, family planning, agricultural development—the basics—and combining the shift with economic reforms, and doing it all with a great deal of success.

**TR:** Why China and not, say, India?

**BROWN:** It may have to do with the quality of leadership. I think China happened to have leaders who understood the issues and were both intellectually competent and politically sensitive. India hasn't had that kind of leadership for some time. China was willing to look ahead and face the future. India is reluctant to do so.

**TR:** Why did China first decide to act?

**BROWN:** What the Chinese have done, and what few other national governments have done, was take a serious look ahead. They discovered that if each couple had two children, they would add another 700 million people or so before the population would

stabilize. They looked at that in terms of what it meant for land and water and energy and jobs and housing, and they realized that two children per family would do them in. They could not sustain the improvements that they had achieved during the century's third quarter following the revolution. So they moved vigorously on the population front and began pushing for a one-child family. Politically difficult though this is, it is preferable to falling living standards and, eventually, famine. Ethiopia, on the other end of the spectrum, has chosen to ignore family planning and is checking population growth through periodic famine.

**TR:** In the case of reforestation, what is China's motivation? Is China's reforestation program based on a serious erosion problem or a need for more fuelwood?

**BROWN:** Both. They're keenly aware of the effects of vegetation loss on both wind and water erosion. When I was in Beijing three years ago, my flight to Xian was canceled because of dust storms. Part of the economic reform has been to give villagers title to land on deforested hillsides with the idea that if they plant trees and restore the forests, they'll be able to harvest the forest products.

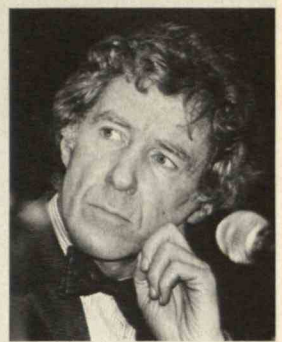
Ironically, the success of economic reforms has made it more difficult to reverse the deforestation trend and start increasing the number of trees in China. Once people in the countryside started earning more money, they all seemed to want more housing. And so the Chinese were chewing up all the lumber in sight and putting enormous pressure on the remaining forest reserves.

### The Political Arena

**TR:** Since leadership seems crucial to world environmental issues, would you compare for us your ten years with the Department of Agriculture to the current administration?

**BROWN:** I had the good fortune of being there when the Kennedy administration and Orville Freeman came in. The lights burned at night. It was an exciting time, with a group of people in office who believed that government did have a role to play, a very constructive role. I was fortunate to be working with a secretary and two presidents who were concerned about the issues. We used to do memos for LBJ about the food situation in India. It was nice to have a president who knew what phosphate was. You didn't have to draw pictures for him.

The interesting thing is that two of the most exciting recent advances in this country—the soil-conservation legislation and the



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*Two possible global security budgets (in billions of dollars)*

| GLOBAL SECURITY | DEFINED IN MILITARY TERMS               | DEFINED IN SUSTAINABLE DEVELOPMENT TERMS |   |                             |
|-----------------|---|--|---|-----------------------------|
|                 | Current Military Expenditures Continued | Military Expenditures                    | Expenditures to Achieve Sustainable Development | Total Security Expenditures |
| 1990            | 900                                     | 854                                      | 46  | 900                         |
| 1991            | 900                                     | 825                                      | 75  | 900                         |
| 1992            | 900                                     | 797                                      | 103   | 900                         |
| 1993            | 900                                     | 771                                      | 129   | 900                         |
| 1994            | 900                                     | 755                                      | 145   | 900                         |
| 1995            | 900                                     | 755                                      | 145   | 900                         |
| 1996            | 900                                     | 756                                      | 144   | 900                         |
| 1997            | 900                                     | 757                                      | 143   | 900                         |
| 1998            | 900                                     | 758                                      | 142   | 900                         |
| 1999            | 900                                     | 750                                      | 150   | 900                         |
| 2000            | 900                                     | 751                                      | 149   | 900                         |



appliance-efficiency standards—have come during the Reagan administration. But both have come from the environmental community, working through the Congress and then going to the White House at the end, rather than the administration taking the lead. If we had had a foresighted government attuned to these issues, think of what could have happened.

**TR:** What is there to look forward to? What are your hopes for the next four years?

**BROWN:** There are a number of things to keep in mind. One, there is a foundation of public awareness to build on that didn't exist several years ago. An administration that's sensitive to these issues could get off to a quick start, and you could see things happen

very quickly.

Can we respond to the threat of climate change as a civilization? I don't know. If we don't move to head off the warming trend, it's not too difficult to envisage a time not far down the road when the capital requirements of adjusting the global economy to the changed climate would absorb all available investment capital. Contemporary agriculture, with its irrigation and drainage system and its cropping patterns, is keyed to a climatic regime that has changed little since agriculture began. Coping with a rising sea level could require extraordinary expenditures to protect the rice-growing deltas and rich flood plains of Asia. Protecting the world's low-lying cities could be even more costly. Such huge outlays could bring economic progress to a standstill. □

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# There's More to a Line than Its WAIT

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BY RICHARD C. LARSON

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**W**HEN I bought a red bike for my son Erik, I received a sales slip and was told to give a copy of it to a clerk at the inventory/checkout window. Arriving at the window, I noticed a woman on the verge of tears. She had been waiting 30 minutes for her purchase while many other customers had come and gone. Soon I, too, saw many customers arrive and collect waffle irons, quilts, and automatic coffee-makers. Some 35 minutes later, I was given a box containing the red bike, and I left with my frustrated friend still anguishing over her ever-increasing delay. I was so mad that I returned the box unopened the following Saturday and purchased a different bike at a respectable bicycle shop with good personal service and a higher-quality product.

My shopping experience coincided with research on the way customers experience lines or "queues," work I'd just begun with colleagues at M.I.T. As an electrical engineer in this venture, I'm part of a tradition begun by Danish telephone engineer A.K. Erlang, who in 1917 invented mathematical queuing theory to help "size" telephone switching systems—that is, determine their capacity so the chances of getting a busy signal can be kept to an acceptable minimum.

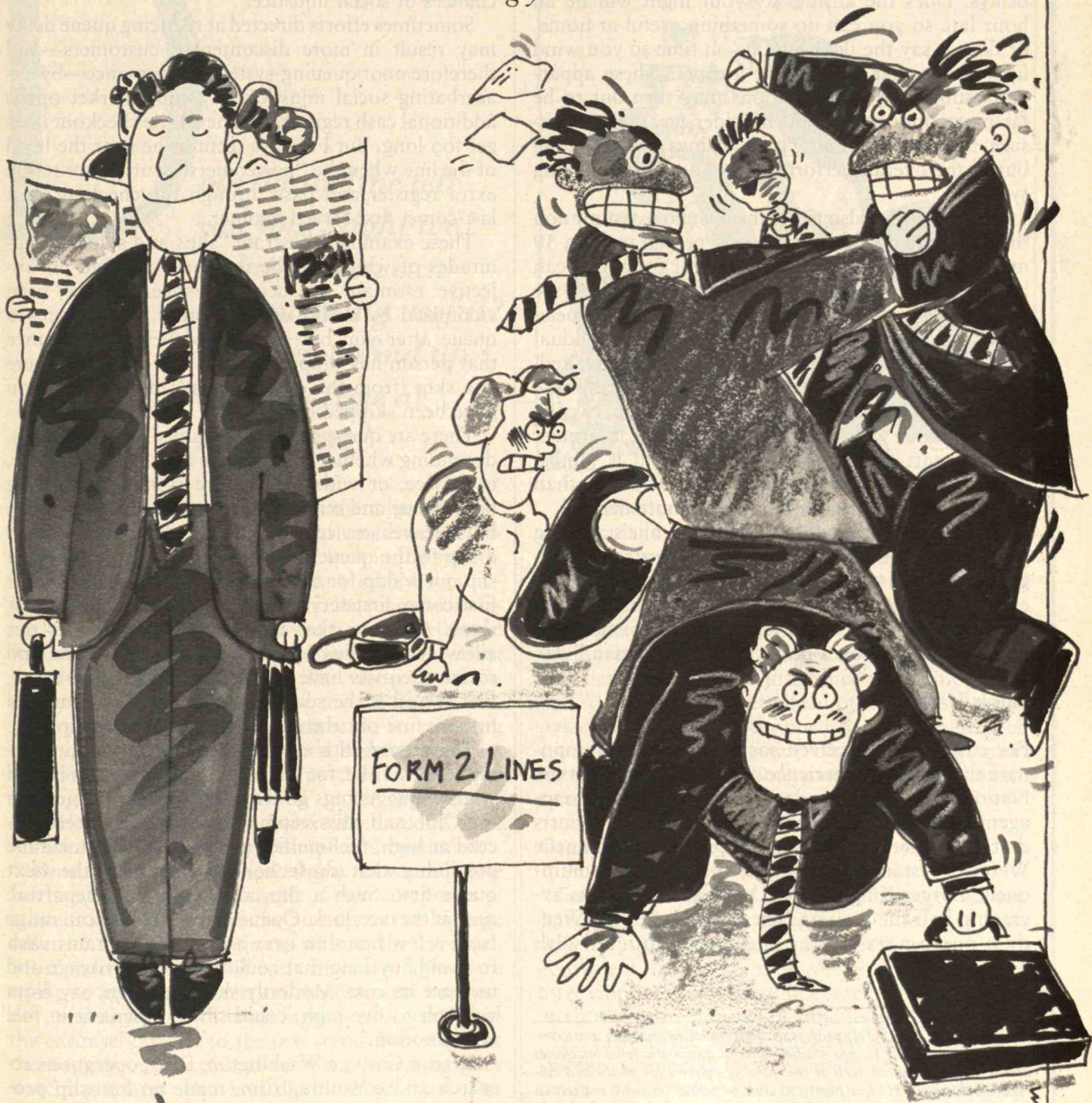
Over the years, telecommunications has continued to be a primary application area for queuing theorists, with many productively employed at such world-class institutions as AT&T Bell Laboratories. Today's queuing engineers help design digital communications systems, schedule operators, and undertake related tasks, all with an eye toward reducing delays. Ever since its birth, queuing theory has also served broader service industries trying to decrease their customers' discontent. Banks try to devise efficient queuing systems to reduce customers' waiting time at the teller's window. Airlines try to get baggage to travelers as fast as possible. Police departments try to reduce the response time to emergency calls.

Much of this work has placed an undue emphasis on the average or mean delay in queue. Recently it has become clear that other factors may be more significant than mean waiting time. Social justice is one such factor. Are you getting served last even though you arrived first, as I and my friend were at the department-store window? Queuing theory has designated first in, first out as the measure of how socially just any particular queuing system is.

The waiting environment is a second factor. Are you sitting in traffic staring at a stalled car,



*"Queuing theorists" are starting  
to realize that what happens to you while  
you're in line is more important  
than how long you're there.*



60 Van



or are you in animated conversation with a friend? A third factor is what feedback you are given about delays. Does the airline say your flight will be an hour late so you can do something useful at home, or does it say the flight will be on time so you wind up wasting that hour at the airport? These apparently subjective considerations may turn out to be far more important than the older mean-time measure, not only in people's own feelings about waiting but in the overall performance of an entire queuing system.

Older theories also make the mistaken assumption that individual experiences—one person waiting 30 minutes and another 10 minutes, for instance—can be lumped to produce an average cost (in this case 20 minutes), since the idea is to reduce the mean wait. But the cost of a given wait to an individual may not be at all proportional to the time waited. The extreme case is an emergency medical response to a heart attack. Often treatment within two or three minutes will save the victim, but if treatment doesn't start within five minutes, death is almost certain. Clearly a five-minute delay is more than twice as bad as a two-and-a-half-minute delay.

What really matters is the cost of one's waiting experience, not just in money but in frustration, anger, and other stresses. If they understood this principle, industries like fast-food chains, banks, and airlines could reduce their customers' anxieties, better manage their own budgets, and even save lives.

### Fairer Is Better

For customers, perceived social injustice can dominate the waiting experience. Arie Lewin, now at the National Science Foundation and formerly a management consultant to the fast-food industry, reports that customer satisfaction in certain single-queue Wendy's restaurants is higher than in many multi-queue Burger King and McDonald's restaurants averaging half the waiting time. He believes the Wendy's customers prefer the longer queue with

guaranteed first-come, first-served discipline to an "undisciplined" multi-line situation with high chances of social injustice.

Sometimes efforts directed at reducing queue delay may result in more discontented customers—and therefore poor queuing-system performance—by exacerbating social injustice. My supermarket opens additional cash registers whenever the checkout lines get too long. But I always seem to be near the head of the line when the "newcomers" scurry over to the extra register and pass through the checkout in a last-come, first-served manner.

These examples illustrate "slips and skips," magnitudes of which can be measured to yield an objective estimate of social injustice. You've been victimized by a slip when another person joins a queue after you but gets served before you, since that person has slipped by you. For every slip there is a skip (from the other person's perspective, you have been skipped over).

There are queue slips, service slips, or system slips, depending whether the injustice occurs in the queue, in service, or within the entire system comprising both queue and service. If B skips over A in a queue but A leaves service before B, then A has experienced a slip in the queue, a skip in service, and neither a slip nor a skip for the entire system. A queue that is first-come, first-served does not allow queue slips or skips. A system that is first in, first out does not allow system slips or skips. Queuing theorists and social scientists have long believed that first come, first served is the socially just queue discipline and first-in, first-out the socially just system discipline.

Threatened slips can have significant dollar consequences. Take, for instance, barge traffic on inland waterways. As tugs go from one lock to the next on the Ohio and Mississippi rivers, captains often proceed at high, fuel-inefficient speeds to minimize the possibility that those behind will enter the next queue first. Such a slip could delay the departure time at the next lock. Queue delays at locks can range from a few hours to over a day, and captains wish to avoid anything that could lengthen a voyage and increase its cost. Modestly slowing down, say from six mph to five mph, could save 31 percent in fuel consumption.

Ketron Corp., a Washington, D.C., operations research and consulting firm, made an anti-slip proposal that assigns queue positions to tugs. Whenever a particular lock is congested with delays of six hours or more, each tug headed there is assigned a queue

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*RICHARD C. LARSON, professor of electrical engineering and computer science at M.I.T., has studied lines at automatic teller machines and discount stores, as well as the queuing systems for police and ambulance dispatch. He has plenty of time to reflect on these matters as he drives ever so slowly through Boston's Summer Tunnel at the height of rush hour. He would welcome feedback from readers on their experiences waiting in line. A longer version of this article appeared in Operations Research.*



D

*oes the airline tell  
you your flight will  
be late so you can  
do something useful?  
Or do you wind up  
wasting time at  
the airport?*

position at the moment it leaves the adjacent lock. Ketron estimates that this system could reduce annual fuel costs by \$1 million per lock in the system.

My favorite slip-skip case history involves an airline serving the Houston airport. Passengers disembarking from flights that arrived between 7:00 and 9:00 A.M. complained loudly and vehemently about long luggage-handling delays. The vice-president in charge of operations conducted several studies, employed consultants knowledgeable in queuing theory, and even hired additional baggage handlers so that the total baggage delay—the time between leaving the plane and picking up baggage—never exceeded the accepted industry standard of eight minutes. But the passenger complaints continued.

On-site observations showed that the waiting time for luggage delivery consisted of two components: a one-minute walk from the aircraft to the luggage carousel and a seven-minute wait at the carousel. Most individuals on this early-morning flight were trying to get a head start on the Houston business day, and anyone with hand luggage proceeded past the carousel directly to the taxi stand. Passengers at the baggage carousel had to spend seven minutes watching others who had disembarked later start their business day first. Those who were victimized by perceived slips complained. Those who enjoyed their skips said nothing.



The solution: a sleight of hand by which the delay was actually increased, while passengers' perceptions of it were transformed. The disembarking location was moved from the main terminal and the most distant carousel selected for luggage delivery, so that total walk time was increased from one to six minutes. After this delay was added, the system was perceived as more just, since people no longer had to watch others get ahead of them. As a result, passenger complaints dropped to almost zero. Perceptions of social injustice clearly mattered more here than the actual time passengers spent in the system.

### Organists and Cat Shows

"*Tedium, ennui . . . boredom,*" wrote William James in "The Perception of Time," "are words for which . . . every language known to man has its equivalent. It comes about whenever, from the relative emptiness of content in a tract of time, we grow attentive to the passage of time itself."

As early as the 1950s Russel Ackoff, professor of systems science at the University of Pennsylvania, made the elevator environment part of queuing-theory folklore. According to Ackoff, high-rise hotels investing in floor-to-ceiling mirrors next to elevators allow the people waiting to fix their ties, comb



**W**hen the walking time to the luggage carousel increased and waiting time decreased, complaints dropped almost to zero.



their hair, and even flirt coyly with fellow time-servers. The queue-wise hotels in question, he wrote, received far fewer complaints about elevator delays than did their mirrorless competitors.

Alain Martin, a Toronto-based consultant specializing in perception and time management, reported that after a certain California bank tried to improve efficiency by installing computer terminals next to each teller, many customers canceled their accounts and opened new ones at a nearby non-computerized bank with twice the average service time. Most of the customers turned out to be laborers depositing their Friday paychecks on their noon lunch hour. The mean service time at the computerized bank was a scant 30 seconds, but the tellers appeared to be inefficient because they had to spend 90 percent of those seconds waiting for the computers, overloaded in the lunch-hour rush, to respond. At the second bank the wait was 60 seconds, but because the tellers seemed continuously busy, customers were happier.

Martin's solution: the computerized bank replaced clocks, which conveyed only the tedium of time's passage, with lively green display terminals showing time, weather forecast, publicity, bank interest rates, and the latest sports scores. The bank also added two TV screens in the waiting area and erected partitions to hide each terminal from customers so that tellers always seemed busy. In addition, the separate queues were made into one line feeding all the tellers—a simple way of avoiding slips and skips. Martin, who had worked on the Houston airport problem, called this a perception management situation, and solved it by combining environmental and social-justice principles.

Some banks have done even more spirited environmental end-runs around potential customer frustration. The happiness of customers at the Manhattan Savings Bank, one of the fastest-growing savings banks in New York City, depends not on extra tellers or new computer technology, but rather on the fact that there is live entertainment every day from ten to two in most of the bank's offices. To its original entertainment—piano and organ music—the bank has now added week-long purebred-dog exhibits, cat shows, and a Christmas ice show. So successful have these ventures been that, according to the *Wall Street Journal*, an enterprising individual has sold tickets to one of the shows—unbeknownst to the bank.

Entrepreneurs would do well to recognize the po-



tential for marketing goods and services to those standing in line. In the United States, if 200 million individuals spend an average of 30 minutes per day waiting in lines, that adds up to roughly 37 billion hours a year. (This figure is clearly speculative. But though I admittedly live in a traffic-congested city, 30 minutes per person per day seems conservative. Consider the time spent sitting at traffic lights, purchasing necessities, and waiting in post office lines and bureaucratic offices.) Since it is said that the average American watches four or five hours of television a day, the time spent in lines would appear to be perhaps a tenth as much. The private sector spends around \$25 billion a year on TV advertising that viewers may choose to ignore, so \$2 billion to \$3 billion doesn't seem a high price to pay for marketing products to queue-waiters with no relief for their boredom.

The idea of changing empty into useful time is of course the rationale behind mobile cellular phones, by means of which business people carry out telemarketing and other activities while they're stuck in rush-hour traffic. Others stuck in traffic are using tape cassettes to learn foreign languages or listen to novels.

"I think the worst thing in the world is waiting," wrote "Thoughtful" in a "Confidential Chat" column on November 17, 1984, in the *Boston Globe*. Among the responses to Thoughtful's letter was the following: "I used to feel as you did about waiting. It was awful. I was so impatient. Now it is different because I am different. I use the time spent waiting to my advantage.

"Here are a few of the things I do while waiting: I think about good things, projects I would like to do . . . I plan out the details in my mind. I pray instead of stewing . . . I read . . . I knit . . . I made seven afghans last year while I was waiting in hospitals. A side benefit was that I made a lot of nice acquaintances because people stopped to talk to me about what I was making.

"To sum it up, I kind of make the time I wait work for me, and I keep it simple . . . Here's hoping you, too, can turn it around!"

Signed, *Queen of the Lilacs*.

### Knowledge Is Comfort

Knowing how long one has to wait doesn't change the delay, but it can certainly help relieve stress. Disney World and Disneyland post signs along



**I** think about good things, I pray, I read, I knit. I kind of make the time I wait work for me."



**O**n any given day subway riders perceive service to be near the worst experienced during the preceding week or month.

queuing channels indicating anticipated delays to the various amusements. At a conference I attended, a petroleum corporation was said to have directed some of its service-station attendants to stand at the pumps holding the hoses so customers would know they wouldn't have to wait to get gas.

Air passengers experiencing a 30-minute wait with no feedback from the pilot usually seem much more annoyed than those told at the beginning that they will have to wait a half hour. However, there is also the irritation of being told about a 30-minute wait when the actual delay is twice as long. (It would seem better for airlines to slightly overestimate delays: passengers would be pleasantly surprised at takeoff.)

Feedback doesn't need to be direct. A customer waiting in line might have a better experience entering it behind ten individuals, each of whom is observed to require precisely one minute of service time, than behind one individual who eventually requires ten minutes' additional service time. The hypothesis here is that the feedback of steady observed "progress" would convince customers they will enter service for sure after ten minutes of wait. This is clearly more comforting psychologically than not knowing when service will be initiated.



### Responding to Emergencies

In any of the foregoing examples, it is irrelevant to use mean waiting time as a performance measure. The rules that determine who gets served next don't change the average wait: that stays the same no matter which system is chosen. Depending on the mean to measure response effectiveness in certain emergencies like crimes and fires isn't only insufficient, but potentially destructive as well.

The probability of arrest near the scene of the crime is highest within one to two minutes after the crime is reported, and it drops roughly exponentially until ten minutes have elapsed, at which point arrest probability levels off. For many fires in buildings, the dollar damage follows an S-shaped curve in which the two most important phases charted are incubation—the fire's slow beginning—and escalation—when the fire's rate of change, severity, and heat increases the fastest. If fire fighters arrive within the gently sloping incubation period, the dollar damages will be kept to a minimum.

In the 1960s the Boston Police Department got problematic results from a telephone answering system that relied on the mean-wait notion of queue performance. Each of up to 14 operators had to



work with an identical toggle switchboard on which each toggle represented a potential incoming telephone call. Next to every one of these switches was a small green bulb. A blinking green bulb signified that a caller was in line waiting to be answered. A continuously illuminated bulb showed that the caller was connected and speaking with an operator. During congested periods, especially on Friday and Saturday evenings, five to ten green lights would be blinking at the same time, and operators would switch from one to the next at random, since they couldn't recall the order in which the lights had begun to blink. The operators were implementing what queue theorists call service in random order.

What happened, of course, was that many people had to wait longer than others even though they had called in earlier. Clearly the random response system posed an unnecessarily high risk to the calling public. What was needed was greater social justice, but at the time there were no technological means for achieving this. Only in the late 1970s did digital technology make automatic call distributor systems possible. These systems, which can manage calls on a first-come, first-served basis, are now in use by the police departments in Boston, New York, and other major U.S. cities.

Police departments have also been paying attention to the idea of quick feedback I described above. In cities like Worcester, Mass.; Wilmington, Del.; and Kansas City, Mo., studies show that citizens calling 911 (the police emergency number) to report certain lower-priority incidents are rarely dissatisfied with police service if they are told the approximate magnitude of the delay they can expect and the reasons for it. Even delays of an hour or more appear to be acceptable. Many police departments are therefore trying to implement a "differential police response strategy" in which lower-priority calls are deliberately delayed a half-hour to two hours to leave patrol cars free for high-priority incidents.

### Pondering the Imponderables

With few exceptions, queue characteristics beyond mean waiting time have been the subject of folklore and haven't been considered for systematic study. But while some researchers feel customer attitudes are subjective and therefore not rigorously measurable, it is also true, as marketing research shows, that attitude changes can make customers switch brands, thereby affecting corporate market shares.

Subjective factors clearly can be measured with reference to such notions as slips and skips.

There are imponderables that go beyond what I've described here. For example, Arnold Barnett of M.I.T.'s Sloan School of Management reports a kind of worst-delay "memory persistence" among subway passengers. On any given day, they perceive the service level to be near the worst experienced during the week or month just preceding.

Michael Rothkopf, a senior staff analyst at the University of California's Lawrence Berkeley Laboratory, argues that merging separate queues into a single one—a strategy widely advocated for queuing efficiency—may be ineffective, since it so often depends on the standard reduction of mean delay. In fact, says Rothkopf, there are important issues that have little to do with the old standard measurement. If customers can know queue lengths before arriving, and if they can "jockey" for queue position after arriving without wreaking havoc on the social-justice scale, then separate queues like express checkout lanes may be the best solution. Or personal imponderables like the acquaintanceship of servers with individual customers may dominate. The 1973 gasoline crisis showed that during goods shortages, customers seem more drawn to long than short queues, perhaps because they feel those in line have inside information on impending stock-outs.

Understanding such subtle factors may do good all around. Queue-system managers may find less expensive ways to reduce queuing frustrations than the standard addition of servers or technology. Customers may have waits that are more pleasant. And firms looking for extra customers may redesign their services with an eye to better understanding how each of us answers the proverbial question, Is it worth the wait? □

### RECOMMENDED FOR FURTHER READING

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**If they are to succeed later, children should learn cognitive skills as early as possible. And parents need to understand how important it is to guide children in independent problem solving.**

**After participating in Advance Educational Programs for Parents and Children in San Antonio, Tex., Grace Hernandez nurtures the language and reasoning skills of her two-and-a-half-year-old daughter Lozena.**





# Educating More Minority Engineers

**T**HE engineering profession can take pride in having increased the number of minority graduates by a factor of 10 in the last 15 years. Yet minorities, excluding Asian-Americans, still constitute only about 6 percent of all seniors graduating from engineering programs.

A recent flurry of reports about the need to increase the number of minority engineers has renewed public interest in improving opportunities for minority students. But the problem cannot be solved by more and better programs in engineering schools alone. They are already dipping deeply into the pool of well-prepared minority students. The challenge is to significantly enlarge that pool.

The value in increasing the number of ready candidates is significant not only as a



matter of social justice but also because minorities, largely consisting of Blacks and Hispanics, will constitute 30 percent of the U.S. population by 1990. To remain economically competitive, the United States must draw on these groups to increase the numbers of professionals in engineering and other scientific fields.

Better science education early on will also increase the number of technologically literate citizens. Our nation desperately needs citizens who can use numbers and language precisely and solve problems analytically.

## What Happened to One High-School Class

Statistics reveal just how small is the pool of non-Asian-American minority students who can be expected to complete engineering

*The pool of minority high-school students who can become engineers is very small. Better education is needed at an early age—not just during college.*



studies. For example, I estimate that of some 146,500 Black high-school seniors in 1981-82 who took standardized college-admittance tests, just about 6,600—5 percent—scored well enough to get into moderately selective engineering programs. (Many programs require combined Scholastic Aptitude Test scores of at least 1,000, or 25 combined points on the American College Testing Program Assessment test.) The following fall, engineering programs attracted a slightly higher number of Black students than this total—about 6,700. Since only 50 percent of test-qualified students entered engineering programs, this means that some schools accepted students with lower scores.

Four years later, about 2,100 Black students received bachelor's degrees in engineering. In all, about 4,100 Blacks, Hispanics, and American Indians received baccalaureates in engineering in 1985-86, compared with 73,700 other students.

By the 1986-87 school year, the percentage of Black seniors whose test scores qualified them for admittance to most engineering programs had risen a little—to roughly 6 percent, or about 8,600 students. That's an improvement, but we must still ask why so few minorities can enter engineering and science programs.

The problems begin early. Many minority students come from families that cannot effectively support academic achievement because education beyond high school is not part of the parents' experience. They may not reward their children for learning ways to solve academic problems—even rudimentary skills such as allowing adequate time for school tasks. This easily applies to one-third of the parents of some 100 students I work with annually in New York City and New Haven, Conn. For example, parents may not keep on hand a dictionary or adequate supplies of items like pencils and paper, or maintain a protected space where their children can work.

At the same time, many minority families use ethnic dialects or languages that are not used in the classroom. These languages are rich and functional in the home culture, but place minority children at a disadvantage in academic settings where a standard English dialect is required.

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**RIGHT: Only 5 percent of Blacks—compared with 27 percent of other students—who expected to graduate from high school in 1982 scored at least 1,000 on the combined SAT exams or 25 on the combined ACT exams. Some engineering programs accepted Black students without these scores—as shown by the number of Black freshmen**

**entering programs the next fall. Only 31 percent of these Black enrollees received engineering degrees, compared with 70 percent of other engineering students. But the proportion of all qualified Black secondary students who became engineers is 32 percent, compared with just 18 percent of the other students.**

These families also often teach their children to use words and numbers in informal and imprecise ways. Research in the 1960s showed that lower-class families are less likely than middle-class families to use language in a precise, detailed manner. For example, parents in low-income families are less likely to explain their reasoning when they tell a child not to do something. Yet learning to use “elaborated” language is critical in school and scientific and technological fields.

John Monroe, a dean at Harvard College in the early 1970s, was so concerned about better minority education that he resigned to become dean of freshmen at Alabama's Miles College, a historically Black



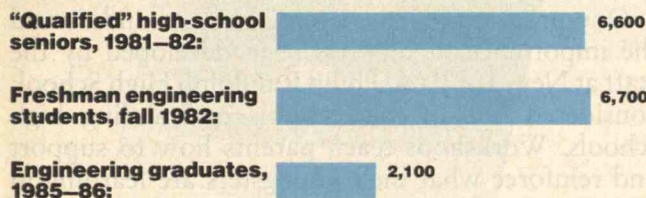


**Minority children often lack sufficient exposure to science and technology. Students associated with intervention programs offered by Purdue**

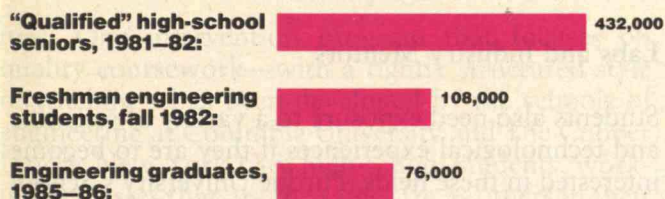
**University's engineering school (left) and California's Mathematics, Engineering, and Science Achievement project try out hands-on activities.**

#### HISTORY OF THE CLASS OF 1985-86 WITH ENGINEERING DEGREES

##### Black Students



##### Other Students



school. He concluded from a study at Miles that academically weaker students are not only deficient in vocabulary but also lack competence in reasoning logically and weighing evidence. Unfortunately, many elementary and secondary schools do not pick up where families may have left off. As a result, minority children often become confused and incapacitated, and cannot learn at the expected, competitive pace.

More obviously, minority children often study in schools that aren't prepared or willing to provide the courses in mathematics, science, and humanities that are necessary to get into and succeed in college.

As a result, in New York City as many as 25

percent of the public high schools—which serve mostly minority students—have no graduates who earn diplomas endorsed by the state Board of Regents, a standard credential. Nationwide, just 72 of every 100 Blacks graduate from high school, compared with 83 of every 100 whites. Even smaller percentages of Hispanics and Native Americans complete secondary training.

#### Content Rather Than Learning

Efforts to compensate for drawbacks in education for minority and low-income students have flourished since the mid-1960s. These programs seem to have improved achievement patterns somewhat. But in a 1987 review I conducted for the Exxon Education Foundation, I found considerable unevenness in the quality of the compensatory programs offered in elementary and secondary schools around the country. Few were comprehensive and well executed. Too many stress only standard curricula, and focus limited attention on weaknesses in students' preparation for learning.

Consider the pre-school Headstart programs. While they have helped considerably, most Headstart classes concentrate on teaching information and socialization skills, and often neglect reasoning and problem-solving skills.

Another problem is that many intervention programs for elementary and high-school students remove children from their classes and place them in sections taught by instructors who may not be as skilled as the classroom teachers. Too often the educational system is organized so that good teachers are rewarded by being moved to easier classes.

Moreover, in many intervention programs instructors reduce the work pace because the students are deemed unable to learn as fast as other children. Instead of offering enriched learning experiences—mixing hands-on activities, including time at computers, with attention to individual students' needs and carefully structured learning—too often watered-down programs simply teach the general curriculum very slowly. As a result, these students have an even harder time catching up with classmates.

Worse, too many intervention programs provide help in name only, serving merely as after-school babysitters for groups of children who change daily.

Some programs claim high rates of success in helping students graduate from high school and advance to competitive colleges. But too often these programs



are rated effective because they work only with the best-qualified students. It is important to help these students advance their skills, but it is easy to ignore others who persistently test in the bottom quarter on achievement exams.

### Learning How to Learn

A successful curriculum should give students an awareness of what they are doing and how they are thinking while learning. Techniques that teach these cognitive skills have been developed mostly for the secondary level. My colleagues and I have worked with three high schools that help teach such skills.

Instructors ask the students to solve problems pertaining to real-life experiences that involve mathematics and science. The students have to sift out relevant information from other facts and combine isolated bits of knowledge into appropriate concepts. They learn to identify important relationships and make inferences from the available evidence. Practice helps students become proficient at these skills.

Traditionally, educators have believed that younger students should concentrate on mastering content. But Benjamin Bloom, professor of education at Northwestern University, has found that if a child is not raised in an environment in which cognitive development is emphasized from birth, intervention after the third year of life becomes progressively more difficult. Introducing five-year-old children to the process of learning isn't impossible, but it is harder. Educators would do better to teach cognitive skills very early and help students catch up on content later.

Learning how to learn has its limits, of course. Students who are not growing up in an environment that rewards cognitive learning have a hard time transferring and generalizing this knowledge. If parents or other caretakers do not reinforce these skills, they are often lost or are confined to the environment in which they are learned.

We do not yet have a complete solution to this problem, but it appears that working with parents as well as with children can help. In tests, we have found that some parents who come from disadvantaged homes themselves are so intent on having their youngsters succeed that when given the opportunity, they consistently try to solve problems for their children. These parents need to learn how important it is for children to figure out solutions to problems on their own.



One program that is helping parents understand the importance of this has been developed by the staff at New York's A. Philip Randolph High School, considered one of the nation's outstanding high schools. Workshops teach parents how to support and reinforce what their youngsters are learning in school. For example, the staff stresses the value of asking questions and rewarding children for taking time to think through problems.

### Labs and Industry Mentors

Students also need exposure to a variety of scientific and technological experiences if they are to become interested in these fields. Purdue University's School of Engineering and Technology, which offers an intervention program for students in sixth through ninth grade, includes hands-on, engineering-lab experiences, field visits to local technology companies, and instructors from industry and academia.

Similar programs are included in the statewide Mathematics, Engineering, and Science Achievement (MESA) intervention project in California. The effort, sponsored by a combination of corporations and state colleges and universities, tries to interest junior-high and high-school minority students in scientific fields. Teams of minority engineers visit schools and youngsters visit college campuses regularly.

Obvious as it may sound, high-school students also need access to a full range of college-prep courses. They should be able to take sequential studies in mathematics, science, languages, and human-

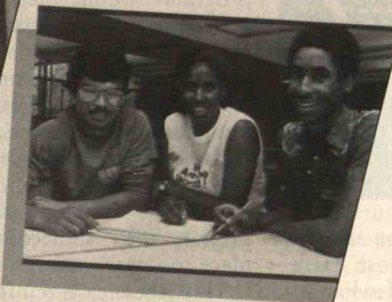


**Minorities are essential to creating a stable cadre of U.S. scientists and engineers. Some targeted programs successfully assist minority students, but more high-quality efforts are required.**



**SET YOUR SIGHTS  
ON A MATH-BASED  
COLLEGE DEGREE!**

Electrical Engineering,  
Computer Science,  
Chemistry Research,  
Astrophysics, Robotics,  
Biomedical Engineering,  
Mathematics Teaching,  
Petroleum Engineering,  
Space Science...



### Supporting College Students

For minority students who reach the college level, educators should offer intervention programs that include cognitive approaches to problem solving. Two excellent mathematics-assistance programs are taught at the University of Massachusetts at Amherst and the University of California at Berkeley. In these programs teachers spend less time lecturing and more time posing questions and problems. Team learning is emphasized. All the classwork and much of the homework is done in groups, with each student's grade influenced by his or her group's productivity. Group learning works because each student is less threatened, everyone feels responsible for one another, and broad approval is gained from academic mastery. Participants in the Berkeley program have been found to be competitive with Caucasian and Asian-American students—whose average is about B—while minority students who do not participate earn averages of about C.

Another effective program, developed by John Monroe, who is now professor of English and writing at Tougaloo College in Mississippi, identifies students' specific academic deficiencies and helps address them. Special attention is given to strengthening vocabulary skills and developing competence in reasoning and weighing evidence.

Socialization to the rewards and demands of academic and professional life is also essential for students whose natural environments have not provided such experiences. Good intervention programs place heavy emphasis on personal psychological support through social and cultural events for minority students. Effective programs—such as one at Rensselaer Polytechnic Institute—also emphasize study skills and faculty and tutorial support. And it is important that colleges and universities make it clear to all faculty members that they should not patronize minority students by setting lower standards for them.

From pre-school to the college level, examples can be found of intervention programs that are successfully preparing minority students for scientific and engineering careers. The effort is not broad enough, however. Enrichment programs must be introduced earlier, and in greater quantity and quality. We must turn matters around soon. A stable cadre of minority technologists and scientists cannot be created overnight. □

ities. One intervention program that focuses on quality coursework—with a tightly structured style of teaching—has been developed by the schools of engineering at Columbia University and The Cooper Union. New York City high-school students, working in classes that are the same size as others in their school, learn algebra, geometry, and trigonometry under the guidance of regular teachers with math certification. Students are constantly drilled and tested. Those who fail to master a concept are immediately given additional help. Although hard data are not available on the program's results, the project seems effective because it emphasizes fundamentals, plenty of practice, and attentive, systematic instruction.

However, the project may turn off students who are not ready for highly structured work. It is difficult to sustain this level of effort in students unaccustomed to rigorous academic life. In addition, I think the program may not be enough. Drill fixes knowledge. People also need to be able to solve multiple types of problems in fields that change constantly. For that capability, students have to know how to learn.



## Mirroring the Mind and Japanese Imitation

### AI's Limits

*Understanding Computers and Cognition*  
by Terry Winograd and Fernando Flores  
Ablex Publishing, \$29.95  
Addison-Wesley Paperback, \$12.45

Reviewed by Lawrence Hunter

As artificial intelligence moves from laboratory to marketplace, the philosophical controversies that have surrounded it since birth suddenly become practical concerns. Whether or not a machine can think might seem an abstract question when posed in the classroom or a scholarly journal. But when the same machine is being used as an expert to help plan your financial future or diagnose your medical complaints, the question takes on a far more immediate interest.

For this reason, *Understanding Computers and Cognition* by Terry Winograd and Fernando Flores is an intriguing and important book. Winograd is among America's foremost computer scientists and a respected specialist in computerized natural language understanding. Flores was the director of state-owned corporations, and later minister of economics and of finance, in Chile's Allende government. Now, with Winograd, he designs advanced office information systems. Participants in the commercialization of artificial intelligence, Winograd and Flores are also critics of it. They have written a book that not only challenges some of the claims made for the current crop of AI products but also attacks the fundamental principles of artificial intelligence itself.

Winograd and Flores argue that, despite the promises of most AI proponents, computers will never understand language and are not and can never be intelligent. What's more, they say the popular attribution of intelligence to computers will lead to serious scientific and social problems. They propose "a new foundation for design" in which computer systems are fashioned to facilitate human communication rather than to replace people with decision-making algorithms or automated problem solvers.

### Myopic Rationalism

Winograd and Flores' central claim is that "the current theoretical discourse about computers is based on a misinterpretation



of the nature of human cognition and language." The reason is that most AI research is in the mainstream of what the authors call the "rationalistic tradition" of Western science and technology. According to this tradition, reality has an objective existence, independent of the presence of any observer. Cognition is the process by which an individual gathers information about things in the world and builds up a mental model of reality. Knowledge is a "storehouse of representations" used to mirror reality; thought is the process of manipulating mental representations to understand the world.

Winograd and Flores think this description is misguided and turn to thinkers from several disciplines—in particular, the phenomenological philosopher Martin Heidegger and the biologist of perception Humberto Maturana—to describe its shortcomings. To put a complicated argument simply, the authors believe there is no simple correspondence between external reality and internal representations. Rather than symbolic manipulation that mirrors the world, thought actually generates our "reality." We focus our attention on particular aspects of our environment depending on our concerns at the moment, inevitably blind to other aspects of the world. However, in moments of what Heidegger called "breakdown," our assumptions about the world are challenged. Our interpretations can then become the object of explicit consideration and representation.

According to Winograd and Flores, most designers of computer systems, being heirs to the rationalistic tradition, assume that the representations used by a computer have a direct correspondence to reality. This leads to inevitable failures, both in the attempt to build a scientific account of mind and in the design of commercial AI systems intended to serve human needs.

Consider the example of expert systems that codify human expertise in a series of decision rules. They are really more akin to idiot savants than experts; the sometimes impressive performance of these programs within their limited domains may seem like "understanding," but it is mere formal manipulation. A problem arises because the functioning of these systems is often erroneously interpreted by both designers and users as indicating understanding or intelligence. Since people misunderstand the source of these programs' powers, they may also fail to appreciate their shortcomings, and hence place too much trust in their abilities.

This tendency is reinforced by the market hype that, Winograd and Flores observe, typically accompanies the commercialization of AI. They quote a brochure from Cognitive Systems, Inc.—founded by Yale computer scientist Roger Schank—claiming that the company's programs understand language. "We give our computer programs the same kind of knowledge that people use," the brochure reads, "so our programs understand a sentence just the way a person does, and respond in conversational English." Winograd and Flores argue that this is at best misleading and at worst irresponsible. "Even those who believe in the success of artificial intelligence," they write, "view such claims as a gross exaggeration of the capabilities of any existing system."

Finally, the authors question the model of work underlying most AI-based systems. Where designers who subscribe to the "rationalistic interpretation of human action" tend to view work as "information processing" or "decision making" and use technology to automate activities previously performed by people, Winograd and Flores emphasize the social nature of work and conceive of computer technology as a new kind of communications medium.

The members of any organization, say the authors, are constantly engaged in conversations meant to articulate a shared understanding of the organization's goals and to generate mutually acceptable com-



mitments for achieving them. Winograd and Flores have designed an office information system, called The Coordinator, intended to facilitate these conversations and commitments at the center of organizational life.

For example, while most electronic-mail systems treat all messages equally, the Coordinator incorporates some simple linguistic distinctions that organize messages according to different kinds of action such as "requests" or "offers." The recipient then chooses whether to accept or reject these commitments, or to propose another action.

The purpose of these categories is to make communication more effective by making the actions people take through conversation more explicit. While it is too soon to judge the success of such a system, Winograd and Flores' description of the logic behind the Coordinator is provocative and intriguing.

#### Strong and Weak Claims

However, in their focus on what AI-based systems cannot do, Winograd and Flores tend to underestimate what these systems have accomplished. Consider the case of a program marketed by Cognitive Systems known as ATRANS. It parses human-generated telexes requesting bank transfers in several different languages. Thousands of financial transactions are made automatically every day on the basis of the program's reading of these requests. Whether or not it qualifies as "understanding," this capability is significant, at least by virtue of its important economic role.

So, too, with the authors' criticisms of attempts to scientifically investigate the functioning of the human mind. They vacillate between the strong position that science will *never* explain the functioning of human cognition and a weaker claim that there is an enormous gap between the subtle intuitions motivating recent theories of mind and the crude programming tools currently available to produce behavior suggested by those intuitions.

Obviously, it would be foolish to dispute the latter position. Certainly no complete computational theory of cognition has yet been advanced. Cognitive science has a long road to travel before it can offer the kinds of secure explanations often found in other fields of research. But this should not obscure the fact that important insights about the nature of thought, lan-

guage, and intelligence have already emerged from this field.

For example, it is widely understood that resolving ambiguities of meaning in words or phrases is absolutely crucial to understanding language. Winograd and Flores refer to this problem of "lexical ambiguity" in their philosophical critique. However, it wasn't until language researchers began writing computer programs that the importance of lexical ambiguity came to be understood.

Another problem concerns Winograd and Flores' concept of "representation." The term can mean different things to different people. To some philosophers, representations are symbols that actually correspond to reality, like scientific measurements or photographs. This is the point of view that Heidegger criticized. But this is not the concept of representation used by computer scientists. To them, representations are nothing more than the various states of a computer that a program uses to store information or make inferences. The significance of these representations is not in their correspondence to reality but in how useful they are to the functioning of a program.

For a program that controls a robot intended to collect aluminum cans, a good representation of a can would include information useful for recognizing one from sensor inputs and for manipulating it so it ends up in the recycling bin. Although this may seem to be a statement about what cans really are, it is no more than a description of the internal states of the computer useful for accomplishing the program's goals. That is what AI researchers usually intend when they speak of "internal representations." But Winograd and Flores conflate this specific sense of the term with the philosophical one and use the shortcomings of the latter to indict AI research.

Finally, the authors base their critique largely on the methods and results of the 1960s and 1970s. More recent AI-based programs seem to respond to many of the criticisms they raise. For example, "failure-driven" learning programs use information gained from their experiences in ways not so different from Heidegger's theory of breakdowns. And sometimes the authors' descriptions of current work are just plain wrong—for instance, their claim that Minsky and Schank's new theories of evolving mental structures are "connectionist."



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**In Japan,**  
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 form of social innovation.*

Still, Winograd and Flores' criticisms of commercial AI systems are timely, and the philosophical issues they raise must be confronted by researchers and users alike. Rather than demonstrating the impossibility of a computational theory of mind, the authors have sharpened the debate about what should count as artificial intelligence and raised the crucial question of how such systems can be designed to meet human needs.

LAWRENCE HUNTER is a Ph.D. candidate in computer science at Yale University and the author of academic and popular articles on artificial intelligence and computer technology.

## Made in Japan

### *Imitation and Innovation*

by D. Eleanor Westney  
 Harvard University Press, \$25.00

Reviewed by John Junkerman

In the 1870s, when Japanese officials decided to create a world-class metropolitan police force in Tokyo, they selected the Paris police as their model. The French capital was a natural choice because it was reputed to have the finest force in the world. So, after a ten-month fact-finding trip to Europe in 1872, the Japanese government established a police system that replicated, in most formal dimensions, the Paris model.

There was, however, a serious unforeseen problem in the transfer of the French system to Japan. Where Paris was small and crowded, Tokyo was a sprawling, sparsely populated tangle of villages and sub-cities. Where broad avenues traversed the French capital, the streets of old Edo were narrow and blocked by numerous T-junctions, a standard strategy for the defense of castle towns in feudal Japan. What helped make Edo Castle an impenetrable fortress for centuries now made movement around the city a policeman's nightmare.

The Japanese solution to this problem was elegantly simple. Officials dispersed the lowest level of the force into police boxes, known as *koban*, located throughout the city. Originally designed for three-man teams, these outposts remain one of the distinctive features of the Japanese po-



lice. Every major crossing in the city has its *koban*. They are often cited as a key to Tokyo's justly famous safe streets. Since the officers know every building in the area, they spend much of their time giving directions to lost pedestrians.

The creation of the Japanese *koban* is just one of many episodes documented in illuminating detail in D. Eleanor Westney's *Imitation and Innovation: The Transfer of Western Organizational Patterns to Meiji Japan*. For Westney, the Tokyo police boxes are an entirely original Japanese innovation—one that, in adapting the Parisian model to Japanese realities, fundamentally changed it.

During the tumultuous early decades of the Meiji period (1868-1912), Japan underwent its first "miracle"—the leap from feudal fiefdom to modern industrial power. Like Japan's post-World War II economic recovery, the phenomenon of the Meiji miracle poses an intriguing question: How did Japan accomplish in 30 frenzied years what had required painstaking centuries of organizational evolution in the West?

Both of Japan's miracles have been ascribed to the facility with which that society has borrowed—and continues to borrow—from the West. Scholars call this the "late developer effect," which allows Japan to avoid the costly mistakes of early developers. The popular press has been less polite, portraying the Japanese as good copiers who "steal" our inventions and then beat us at our own game.

Westney makes a convincing case that neither of these views is adequate to understanding the Japanese experience. Her major premise is that conventional distinctions between copying and inventing, imitation and innovation, are false dichotomies. In fact, "the successful imitation of foreign organizational patterns," she writes, "requires innovation."

Westney suggests that imitation in Meiji Japan was different only in scope and intensity from the experience of other industrializing societies. When one considers that the West itself was experimenting with new technologies and institutional frameworks during the same decades of the nineteenth century, it is clear that Japan is not a special case. Rather, it exists "far along the continuum on which all societies occupy a position."

### Samurai Cops

The author's detailed organizational histories of the police, postal system, and newspaper industry provide ample evidence that Japanese development was a remarkably complex process that progressed fitfully and found its way by trial and error. While it is true that some institutions were modeled after a single Western prototype, the organizational patterns that emerged over time had many sources. Blueprints were redrawn, sometimes monthly, and nearly every new idea was tried at least once.

For example, the Tokyo police may have been modeled on the Paris system, but it recruited heavily among former samurai, who had been abruptly released from service when the Meiji government dismantled Japan's feudal domains. These recruits brought traditions and codes of practice of their own (for instance, a prohibition against drinking, even when off duty). The famous arrogance of the samurai carried over to the new officers as well, reinforcing an aspect already present in the French system. Meanwhile, the Japanese army provided a model for professional training and education, which the Japanese police adopted three years before the French and decades before most Western police forces.

As might be expected at a time when news and information traveled around the world by steamship, the development of new organizations was often shaped by fortuitous events. For example, it was another government assignment that took



Hisoka Maejima, "the father of the Japanese postal system," to London in 1870. But Maejima had long had an interest in the posts, and he took full advantage of his year-long residence in England to learn the details of the best postal system in the world. The British model thus, almost by chance, came to dominate the early Japanese post.

Maejima made the creation of an effective postal system into something of a personal crusade. Like other Meiji leaders, he was driven by a kind of entrepreneurial nationalism, a desire to win for Japan the respect of the world's leading nations by creating the institutions of a modern society. In this case, a key spur to the development of the post was foreign demand for efficient shipping within Japan. Similarly, the Japanese government pushed the development of the police system in an attempt to revise treaties that had granted foreigners special rights on Japanese soil on the grounds that the authorities could not guarantee their safety.

Westney's third case study, of the Japanese newspaper, deviates furthest from the stereotype of Japan's institutional copying. While the police and the postal systems had explicit foreign models, there was no single prototype for the modern Japanese press, primarily because the Western newspaper was itself in the midst of rapid transformation. So, while the foreign-language press in such international ports as Yokohama and Nagasaki provided a model for some Japanese publishers, others took their lead from the pre-Meiji tradition of serialized novels and produced lavishly illustrated, simply written papers for the masses.

Also unlike the police and the post, the development of publishing was left mostly in private hands. A wide variety of publishers established newspapers, along with related institutions such as ad agencies. Propelled by the steady advance of printing technology, the invention of the telegraph, and growing public demand for news—especially during the Sino-Japanese War in 1894 and the Russo-Japanese War in 1904-05—these efforts helped create new markets for political, cultural, and consumer information.

But there was none of the "stage-skipping" of the late developer in this case. The Japanese newspaper compressed into about 40 years all the stages that other countries traversed over centuries, including elite broadsides, popular newsbooks,

official gazettes, political organs, and finally modern mass dailies.

#### Beyond Simple Convergence

Part of what makes Westney's argument so persuasive is that her cases are so richly detailed. For example, it is fascinating to discover that the reason Japanese newspapers publish both morning and afternoon editions of about 24 pages is that setting type in Japanese is such a daunting task. Printing frequent slim editions was the only way the typographers could keep up with the news. Despite the advent of computerized typesetting, Japanese newspapers retain a format that emerged at the turn of the century.

By carefully presenting such information, *Imitation and Innovation* demonstrates that the process of cross-cultural modeling "simultaneously involves pulls toward and away from the chosen models." In this, Westney raises an explicit challenge to the theory that all societies evolve in similar ways because of the imperatives of industrialization.

However, this is not to say that deviations from such convergence can be explained by "tradition" or the cultural uniqueness of the Japanese. More often than not, Westney argues, Japanese tradition has conformed to Western organizational models, not the reverse—the transformation of samurai into police comes to mind. "The effect is both convergence that does not produce uniformity," concludes Westney, "and variation that is neither random or infinite."

At a time when Americans are repeatedly urged to return the Meiji favor by emulating everything from Japanese management and schools to household savings accounts and tofu consumption, it is useful to be reminded how dialectical this modeling process can be. Unfortunately, Westney makes few attempts to explore this contemporary reverse copying. Nor does she tell us how Japan's police, post, and newspapers fared during the post-Meiji rise of militarism and postwar Americanization—processes that could shed light on our own dilemmas today.

*JOHN JUNKERMAN is a freelance journalist and filmmaker in Somerville, Mass., who has been writing about Japanese society for over a decade. His documentary film Hellfire was recently nominated for an Academy Award.*

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estate—most of it Boston-based—are currently driving the state economy. So much for the idea of reindustrialization.

This volatile economic mix may be especially vulnerable to future disruptions. What will happen if federal military outlays drop over the next decade, as part of efforts to cut the budget deficit? Layoffs and unemployment for engineers and technicians at high-tech firms producing for the Pentagon could result, repeating a pattern seen after World War II and Vietnam. Serious planning will be necessary to create replacement jobs while preserving the invaluable skills of the state's technical workforce.

Second, as labor shortages continue to push wages upward, multinational firms located in the state may shift work outside the region. And small manufacturing firms less able to move and with thin profit margins might have to close down altogether. Unless ways can be found to enable companies to live with higher wages by increasing productivity and exports, higher unemployment seems likely.

Such vulnerabilities are of more than local interest. In its growing dependence on defense spending, the declining competitiveness of whole segments of its in-

dustrial base, and worsening wage inequality, the Massachusetts economy mirrors trends in the U.S. economy as a whole. So, politicians and policy makers should look to Massachusetts as a laboratory for learning how to cope with rapid economic change. But the closer they look, the less likely they may want to buy the existing model. □

**FLORMAN**

CONTINUED FROM PAGE 22

penter grinds cornmeal in Adamsville, R.I. An engineer from Brooklyn quits his job in the defense industry to become co-owner of a yogurt-producing farm in Wilton, N.H. All yearned for rusticity, and a technologically advanced society made it possible for them to realize their aspirations.

Traveling in the opposite direction are the thousands of people who flee what they consider to be the tedium of farms and small towns, seeking careers in industry and the arts, and reveling in the excitement found in large cities. Scientists gravitate to world-class research centers. Academics congregate in university towns. Administrators seek out government service in state and national capitals.

Beyond the attraction of specific vocations lies the more general allure of dif-

ferent lifestyles. Mild climate attracts multitudes to the sunbelt, while a craving for "laid-back" ways draws many to California. Pakistanis drive taxis (or study engineering) in Cambridge (England or Massachusetts) while spiritually inclined Westerners seek enlightenment in the Himalayas.

Having arrived at the places of their choice, such newcomers often show a special appreciation for what makes those places unique. And it is frequently the combination of dedicated natives and idealistic newcomers that is most likely to preserve the distinctive features of any region or environment.

This refutes the pessimistic assumption that, in a technological world, diversity is doomed. Indeed, the ultimate lack of variety is to be found in a life without technology, where human possibilities are constrained by the demands of brute survival. □

**LETTERS**

CONTINUED FROM PAGE 7

particle beam as the best hope for solving the decoy problem, a \$1 billion space experiment was recently canceled because of budget restrictions.

Soviet motivations for opposing SDI are not entirely known, but two factors are undoubtedly important. One is that the country wishes to avoid an expensive competition with the United States in both offensive and defensive weapons. (This is not to say the Soviets would be unwilling or unable to meet the challenge.) Also, Moscow no doubt fears that the United States might launch a nuclear attack and use its defense to blunt retaliation. A partial defense would be far more effective in this role than in stopping a coordinated surprise attack.

Goldie misses the point when he suggests that SDI would strengthen deterrence by raising doubts about whether a Soviet attack would be successful. As both countries already know, any attack would be unsuccessful, in that enough forces would survive to annihilate the other side. The original idea behind SDI was to replace this situation with a purely defensive strategy. If defenses are merely a refinement on the idea that the threat of mutual annihilation is a deterrent, then why go to all the expense?

As a final note, terrorists are very unlikely to get hold of an intercontinental ballistic missile or build one themselves: the technology is just too difficult. If we are concerned about terrorists blowing up our cities with nuclear bombs, we should devote more resources to mundane precautions such as controlling our borders, rounding up international terrorists, and preventing the proliferation of nuclear weapons and nuclear technology.

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The weather was perfect—cool and windless—on March 31, their first morning at Heraklion, Crete. But the *Daedalus* team could try only some test flights—“the first time a human has flown under human power in Crete since Daedalus 3,500 years ago,” wrote operations director Steven R. Bussolari in his daily report. For the next 25 days aeronautical engineer Bussolari became a frustrated meteorologist, plotting a series of lows over Europe and northern Africa that he knew foretold unacceptable winds off Crete. Finally, on April 25, Bussolari foresaw gentle southerlies and the opportunity to create another legend: the flight of M.I.T.’s *Daedalus*.

### Saturating on Safety

Though he admits that some traditional air-safety measures have been abandoned since deregulation, Robert Simpson, director of M.I.T.’s Flight Transportation Laboratory, doesn’t buy the “skating-on-thin-ice” stories. Commercial aviation is safer now than ever before, he says.

Total annual fatalities on all scheduled domestic flights have dropped 25 percent since the early 1980s, according to Simpson’s data.

Fatalities have dropped from about 1 in 1 million airline seats occupied in the early 1970s to about 1 in 6 million today. Meanwhile, the number of commercial planes in the sky has increased significantly and the number of seats occupied has more than doubled.

Simpson admits that the airlines are “cutting corners,” in the sense that they are omitting some things that were done in the name of safety before deregulation. What we’re learning, he says, is that “we

overdid safety in the past and our efforts saturated—we ended up doing a lot of work that really didn’t contribute to safety in any substantial way.”

### New Path to Nuclear Power

The “loss-of-coolant” accident is the bugaboo of today’s nuclear industry, says Lawrence M. Lidsky of M.I.T.’s Nuclear Engineering Department. There’s no way to prove it cannot happen, and society seems unwilling to accept a lesser guarantee.

But there is an alternative, says Lidsky—an “inherently safe” reactor design in which even total failure of cooling and control systems would not be hazardous to the surrounding public. He refers to reactors that might be built on the German “AVR” design in which the fuel is in the form of “kernels” instead of the rods characteristic of light-water reactors. As long as the reactor is less than about 250 mega-

watts capacity, the kernels can survive intact even if the stream of cooling helium is disrupted.

That critical size is less than one-tenth of typical U.S. nuclear plants. But no problem, says Lidsky: for a 2,000-megawatt reactor, simply gang together ten 200-megawatt AVR units. The resulting modular gas-cooled reactor would have three advantages:

- It would be cheaper to build, because the units could be assembled in a central factory.
- The fuel kernels are so small that they are in effect already packaged for safe disposal.
- The reactor’s safety can be demonstrated by full-scale testing—a feature that Lidsky thinks is key to public acceptance.

The 50-megawatt prototype AVR has been operating successfully in West Germany since 1967. Why not in the United States? Inertia, says Lidsky. “The strongest arguments against new power plants come from those who have invested their prestige and money in the older ones.”



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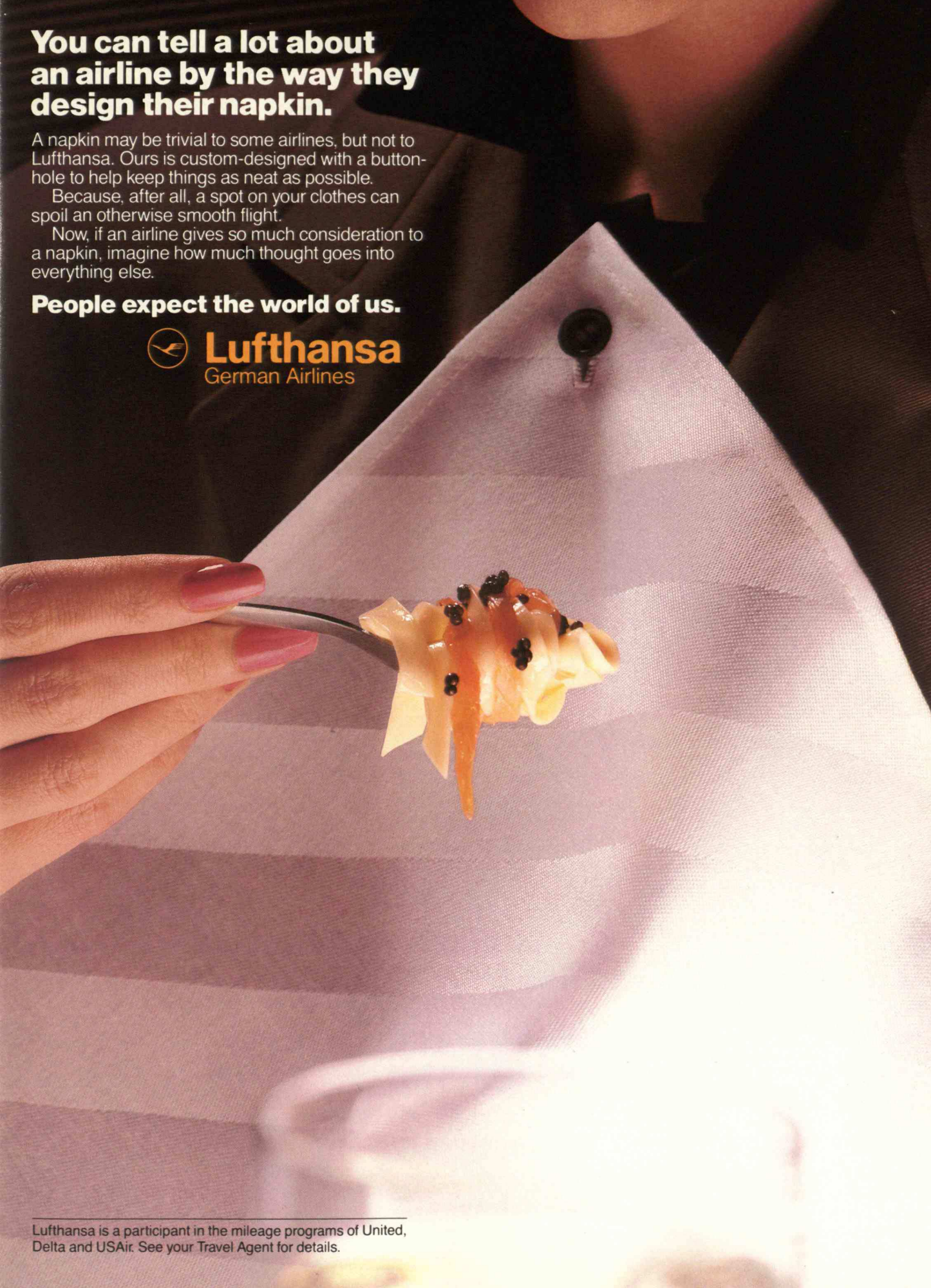
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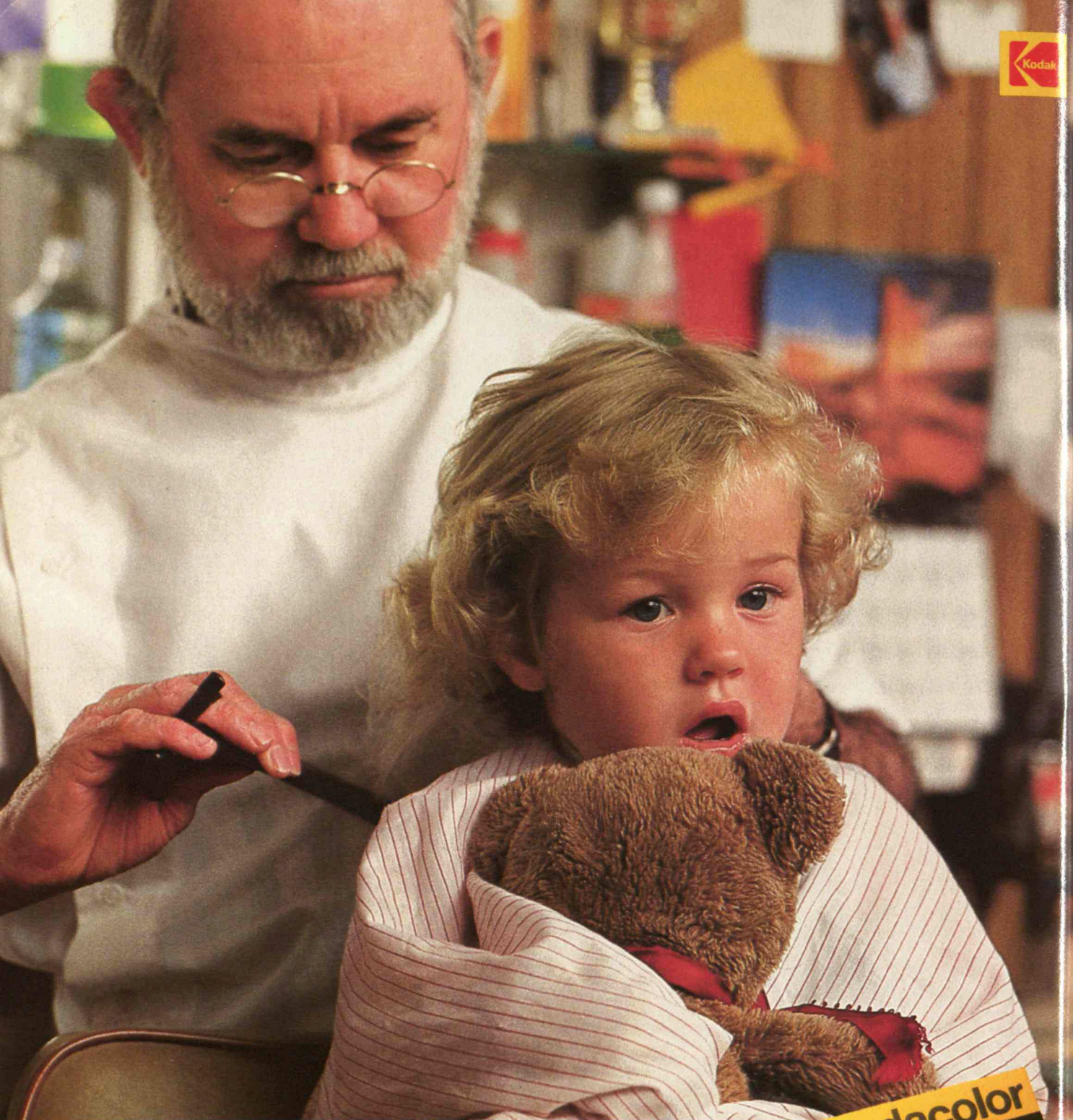


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